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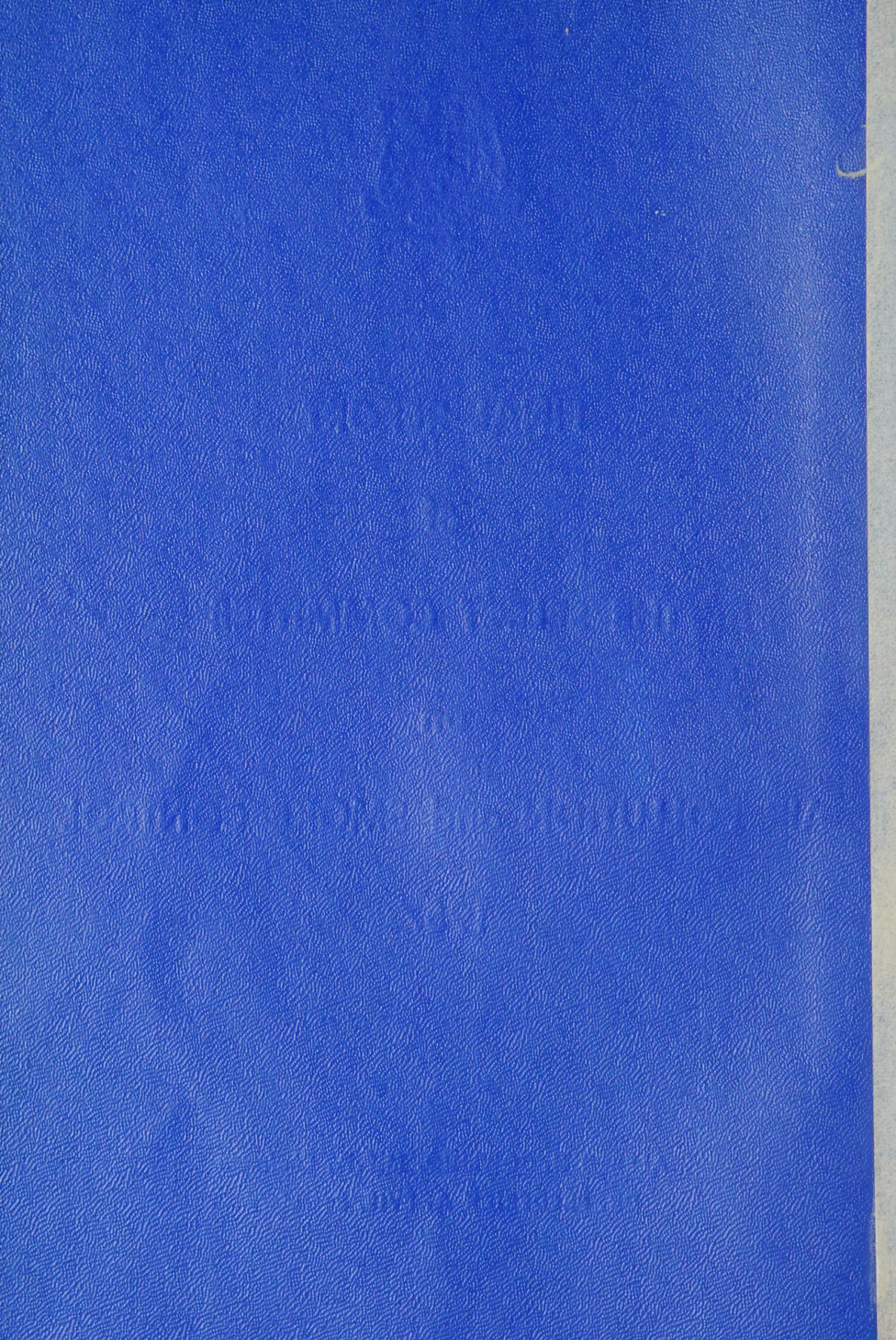
*Ontario Air Pollution and Smoke Control
Select Committee*

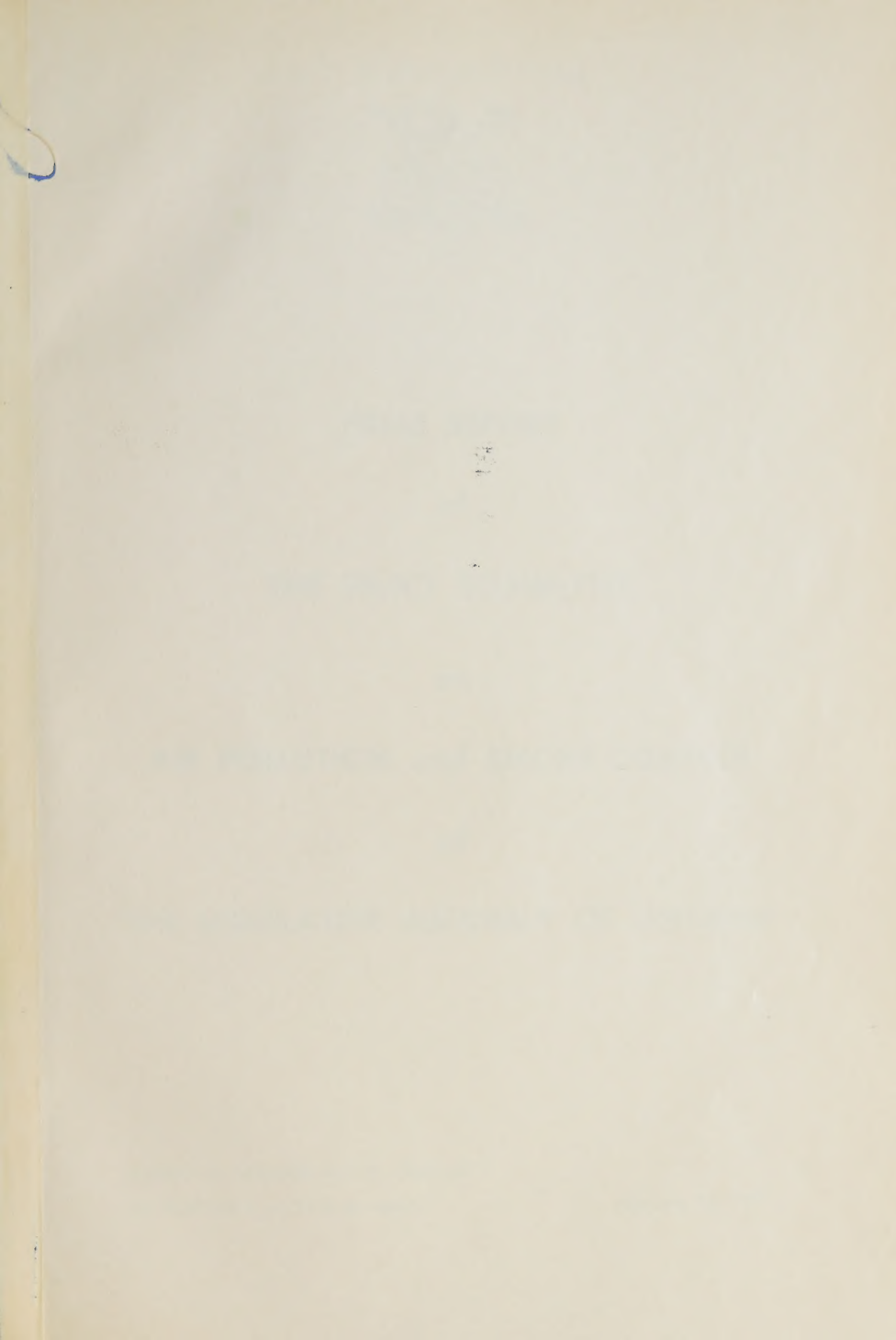



FINAL REPORT
of
THE SELECT COMMITTEE
on
AIR POLLUTION and SMOKE CONTROL
1957

ALFRED H. COWLING, M.P.P., Chairman

DR. FREDERICK A. EVIS, Secretary







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ONTARIO

FINAL REPORT

of

THE SELECT COMMITTEE

on

AIR POLLUTION and SMOKE CONTROL


of

THE LEGISLATIVE ASSEMBLY OF ONTARIO

ALFRED H. COWLING, M.P.P., *Chairman*

DR. FREDERICK A. EVIS, *Secretary*

February 14, 1957



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To The Honourable
The Legislative Assembly
of The Province of Ontario

Honourable Members:

This Select Committee was appointed on September 8th, 1955, during the First Session of the Twenty-fifth Legislature, on the motion of the Honourable Leslie M. Frost, Q.C., Prime Minister of Ontario, seconded by the Honourable Mr. Porter, Q.C., with the following terms of reference:

"That a Select Committee of the House be appointed to examine existing legislation and practice in relation to smoke control and air pollution in Ontario with particular reference to the installation and maintenance of equipment to control smoke and air pollution and methods and ways of extending public information in connection therewith.

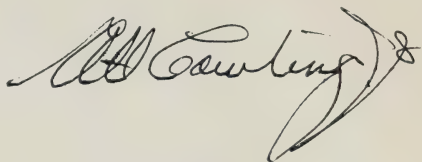
"And that the Select Committee have authority to sit during the interval between Sessions and have full power and authority to call for persons, papers and things and to examine witnesses under oath, and the Assembly doth command and compel attendance before the said Select Committee of such persons and the production of such papers and things as the Committee may deem necessary for any of its proceedings and deliberations, for which purpose the Honourable the Speaker may issue his warrant or warrants."

It is with deep and sincere regret that we have to record the sad loss, by untimely death on July 2nd, 1956, of a most highly esteemed, beloved, conscientious and valuable member of our Committee, the Honourable Member for York West, Mr. W. Elmer Brandon, Q.C. We, the remaining members of the Select Committee, believe that Mr. Brandon would endorse this, our final report, and the conclusions and recommendations contained herein, on which we have unanimously agreed.

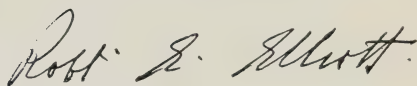
The members of our Committee wish to record their thanks to the efficient Committee Secretary, Frederick A. Evis, B.A., M.D., D.P.H., Barrister and Solicitor, the Medico-Legal Consultant to the Ontario Department of Health and The Ontario Hospital Services Commission, for his helpful services and for the many hours of work which he has unselfishly devoted to the business of the Committee.

This Committee, having completed its work, respectfully presents the unanimous report which follows:

SIGNED:



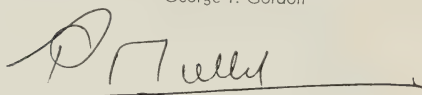
Alfred H. Cowling, Chairman



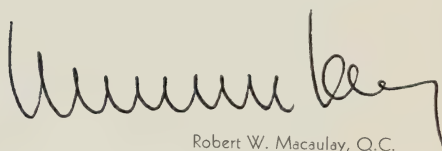
Robert E. Elliott



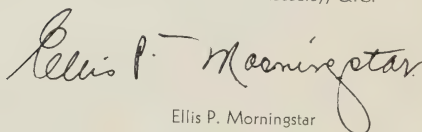
George T. Gordon



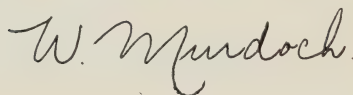
Hon. Philip T. Kelly



Robert W. Macaulay, Q.C.



Ellis P. Morningstar



William Murdoch



Thomas D. Thomas

Dated at Toronto, this 14th day of February, 1957.

Report on Air Pollution and Smoke Control

(A) SUMMARY OF COMMITTEE'S ACTIVITIES

This Committee has spared no effort to comply with the many requests it has received from individuals and organizations concerned with air pollution. Frequently we have held meetings and conducted hearings in the evening hours to accommodate the convenience of those from whom we wished to obtain information and testimony. The data we have gathered is filed for the use of the Ontario Air Pollution Control Commission which we propose be established.

We have visited and studied air pollution and smoke control problems in 42 municipalities, 28 of these in our own province. In 35 of these municipalities we spent considerable time with specialists in air pollution control and enforcement, learning of the facilities available to them for their work and the limitations and difficulties imposed upon them by legislation, by-laws and codes, often very inadequate to enable the enforcing authority to achieve desirable results.

The Committee had personal discussions with experts in the various aspects of the air pollution problem in the state departments of 6 of the United States of America and correspondence has been carried on with other States. We have received the benefit of the experience of a prominent scientist from South Africa and one from Japan. We have corresponded with the outstanding authority in Great Britain and studied his findings and recommendations.

We have read many scientific papers, reports, publications and text books produced in the British Isles and the United States. We have studied the work in progress in 37 research centres; 106 industrial inspections have been made by the Committee through factories, power plants, packing plants, roundhouses, garbage disposal and incinerator installations; 96 reports, petitions and briefs have been presented to and perused by the Committee members. A total of 653 interested individuals made personal appearances before us and 239 experts kindly, patiently and generously gave us the benefit of their knowledge and advice.

To all those who have assisted us in our work we extend our warmest and most appreciative thanks. May we express the hope that our report will result in the passing by this Legislative Assembly of progressive air pollution control legislation and the establishment of an advanced and effective air pollution control system in Ontario of which we can all be justly proud.

We have collected a vast amount of evidence on the subject assigned to us, which is partly contained in 47 volumes of our Proceedings, comprising some 3,622 pages. In addition to this, we have also accumulated a large number of publications of various sorts which have not been copied into our Proceedings. These publications include authoritative text books, air pollution controls legislation from other jurisdictions, municipal ordinances, codes and by-laws, standards and values established and recommended by engineering and other scientific groups, papers and reports describing research and statistical studies, educational methods used and recommended in this field, the history of and the legal and administrative aspects of air pollution control, and specifications for and the results achieved by all types of air pollution control equipment in use today.

It would be physically impossible to present to the Honourable Members this mass of technical and scientific information today. Therefore, we will avoid voluminous technicalities in this report. However, our detailed proceedings on which we base our statements, conclusions and recommendations are available to any Member who may wish to study our sources of knowledge in this field.

Since submitting our Interim Report to this Legislature on March 15, 1956, all the additional evidence we have gathered has only served to verify the opinions we expressed last year, to give us additional reasons which substantiate our tentative conclusions and recommendations, and to make us all the more apprehensive about the growing seriousness, in Ontario, of the effects of air pollution on all of us and our families, on our livestock and pets, on our property and belongings and on our plants and crops.

Air pollution is another of the many problems which are the products of civilization, increasing population, prosperity, and, in particular, living together in cities. Industrialization has produced many advantages for us, but it has also complicated life with a multitude of disadvantages which we have to correct in order to retain and enjoy the benefits of the advantages. Our Committee is convinced that air pollution is one of the more complex, far-reaching and important problems which we must face.

From forty to fifty, or more, distinct and different air contaminants can be individually identified in appreciable quantities in the atmosphere over an average modern city. In Metropolitan Toronto, in Hamilton and in other

Ontario cities there are thousands of tons per day of such contaminants being spewed into the air. We know that the proper application of adequate air pollution controls can literally eliminate from the air we have to breathe many tons of air pollutants every day.

Because there has been considerable commendation of our Interim Report by experts in air pollution control and there has been such a demand for copies that our supply has been exhausted, and because we can reiterate the findings and conclusions to which we came last year, we wish to append our Interim Report to this Final Report, as Appendix "A".

(B) FIVE PRINCIPAL RECOMMENDATIONS

Based upon our exhaustive studies, we have come to the following conclusions and wish to present five principal recommendations for your immediate consideration:

1. THAT AN ONTARIO AIR POLLUTION CONTROL COMMISSION SHOULD BE ESTABLISHED, ORGANIZED AND BROUGHT INTO ACTIVE OPERATION IMMEDIATELY.

An Act containing the modern principles which we recommend for this purpose is appended to this report, as Appendix "B".

The Committee is thoroughly convinced that air pollution is a vital problem and an urgent one which should be attacked promptly, courageously and with the full support of all Parties. This is not a job for amateurs and halfway measures will not be good enough.

The proposed Commission should be financed adequately to enable it to employ properly qualified engineers, scientists, and medical and legal opinion. It should be able to purchase sufficient modern equipment so that it can provide useful and real assistance to municipalities and to industry in determining what contaminants are in the air in any given locality, from what source or sources they originate and the best and proper methods for controlling them.

The Commission should be permitted to carry on technical and statistical studies and research and to make grants to other research centres for the purpose of advancing our knowledge in this complex field. The Committee has already received acceptable applications for grants from two outstanding Ontario scientists who are ready, willing and able to undertake research which will benefit our citizens.

It is true that all this will cost a certain amount of money. We believe that the value received will prove any expenditure made to achieve the control

of air pollution to be money very well spent. Clean air is expensive, but it is far cheaper than foul air.

We recommend prompt action in establishing the proposed Commission because prevention is much cheaper and more satisfactory in every way than cure. Considering the rapid rate at which Ontario industry and Ontario cities and towns are growing, for prevention to be really useful, we must act quickly. Time is of the essence.

As we stated in our Interim Report, experience has shown that air pollution control expenses may be from two to five times as great for the company involved when the correction is applied to an established, operating concern by "fitting the equipment in with a shoe horn," than they are when properly planned equipment is designed for and built into the factory or other building when it is first constructed.

However, it is not only the expense to industry about which we are concerned. There is also the cost to the Government and to the people to be considered. When expensive processes have to be redesigned or equipment which should never have been installed in the first place has to be torn out and replaced, there is likely to be strong protest from the industry or individual concerned, which could delay the cleaning up process by months or even years. Such a situation costs everyone money.

Every day that goes by until the proposed Air Pollution Control Commission is established and in action simply means one more day passes during which construction may be started on some new factory or office building without the benefit of air pollution control advice, or another incinerator may be installed in a new apartment building or duplex which should never be installed at all and which is quite inadequate from an air pollution control standpoint.

We see these new plants, new apartment buildings, new hotels, new office buildings and other new construction going up around us constantly. We wonder just how many of these buildings have been designed without any thought being given to air pollution control. Or what is, in a way, even more regrettable, how many of these places have been planned with the intention of having proper control, but with the equipment being purchased and installed on the advice of some salesman anxious to make a sale of his particular control device, but without the benefit of qualified and impartial air pollution engineering opinion? It is, incidentally, very possible to spend large sums of money for control equipment which proves in practice to be little better than useless because it is not the type or size of equipment which should have been chosen for the particular job to be done. Large, well-known companies have made this costly mistake in the past and have had to do the job over again.

Metropolitan Toronto is said to be growing at a faster rate than any other metropolitan area in the world, not excepting Los Angeles. Other Ontario cities are also expanding rapidly. Our Committee is certain that if we wait much longer to begin our all-out attack on this problem, intelligently and on a province-wide scale, it will really become overwhelming, as it already has in other jurisdictions. It will then require an exceedingly vast amount of work and money to be expended in the future to investigate and correct mistakes and examples of neglect, short-sightedness and false economy which are occurring now, day after day, but which could be prevented if a proper authority were made available to advise the planners of new projects.

Therefore, on behalf of our citizens and our industry, we recommend immediate action by the Provincial Government in this matter.

THE TIME TO BEGIN AIR POLLUTION CONTROL WAS YESTERDAY OR TEN YEARS AGO. Let us not neglect it another day.

2. THAT EXISTING ONTARIO LEGISLATION DEALING WITH AIR POLLUTION CONTROL IS ANTIQUATED AND SHOULD BE AMENDED.

This Committee stated in its Interim Report that there should be no exemptions made in any air pollution control legislation in this Province. We are still of the same opinion. Further, we may add that we have discovered no jurisdiction which permits any exemptions to its air pollution control laws, codes, ordinances or regulations.

Therefore, we recommend that all exemptions, and all provisions which in practice have the effect of creating exemptions, to our air pollution control legislation be struck out of the legislation immediately.

In addition, we recommend that, as soon as the Ontario Air Pollution Control Commission has been established and has started to operate, every section of The Municipal Act, (R.S.O. 1950, c. 243), which purports to deal with air pollution and smoke control matters be repealed forthwith.

3. THAT THE PROPOSED AIR POLLUTION CONTROL COMMISSION SHOULD DEAL WITH THE CONTROL OF AIR POLLUTION ORIGINATING FROM RAILWAYS AS THEY PASS THROUGH THIS PROVINCE.

The Committee is satisfied that The British North America Act, 1867, gave the Province of Ontario the power and the duty to enact legislation to protect the property and civil rights of its citizens and to look after their health and welfare. That being so, the Committee is of the opinion that the Government of Ontario must assume that responsibility, and to that extent, the proposed Commission should be empowered to formulate and enforce air pollution control

limits, codes and rules which affect and deal with railways in order to guard and protect the health, welfare, property and civil rights of Ontario citizens, but bearing in mind the undertakings and responsibilities of the railways.

In Ontario, railways still operate under the provisions of an obsolete Order of the Board of Transport Commissioners, dated November, 1908. On July 13, 1956, at the request of an official of the Department of National Health and Welfare, the Committee drafted a proposed revision of this old General Order No. 18 of 1908. The Committee's suggested revision is appended to this report as Appendix "C".

We should mention that while the dieselization programs of the railway companies, when they are completed, will relieve us of many of the bad smoke nuisances which plague our citizens today, dieselization will not provide a complete answer to the problem of railway air pollution by any means. The visible and the unseen contaminants emitted from diesel exhausts should definitely be controlled on railway engines just as they must be on diesel trucks and busses on our highways. The proper solution for this will probably turn out to be the use of the catalytic exhaust muffler. However, this is a matter for the engineers of the railway companies and of the proposed Commission to thoroughly investigate.

Of course, electrification of railways in and near our cities would be the perfect answer to the railway air pollution problem, because electric engines produce no air contamination whatsoever. Railways are operated electrically in many cities and many countries of the world much to the benefit of all concerned. Electrification of the railway lines in the larger Ontario urban centres would be an expensive proposition, but it is something which should receive careful study. It is quite possible that the results achieved by electrification would more than justify the cost involved.

4. THAT THE PROPOSED AIR POLLUTION CONTROL COMMISSION SHOULD DEAL WITH THE CONTROL OF AIR POLLUTION ORIGINATING FROM SHIPS DOCKED, MOORED OR NAVIGATED IN ANY ONTARIO HARBOUR, OR OPERATED IN WATERS WITHIN PROVINCIAL BOUNDARIES.

The Committee is of the opinion that the Government of Ontario must also assume this responsibility, for the same reasons as those given under recommendation 3, above, for undertaking the control of air pollution from railways, and, similarly, bearing in mind the undertakings and responsibilities of the steamship lines.

With the completion of the St. Lawrence Seaway Project, air pollution from vessels will undoubtedly become even more important to Ontario citizens than it is at present.

5. THAT THE PROPOSED COMMISSION PROHIBIT DOMESTIC INCINERATORS, CONSIDER WITH GREAT CARE WHAT TYPE, IF ANY, SHALL BE PERMITTED AS INCINERATORS FOR APARTMENT HOUSES AND GIVE IMMEDIATE AND SERIOUS ATTENTION TO THE DISPOSAL OF GARBAGE AND INDUSTRIAL WASTES.

The Committee recommends that the Commission investigate and deal effectively with the air pollution nuisances caused by municipal and industrial waste dumps. Also that it study and control the programs of municipalities for dumping and incineration, and recommend to them the most suitable and modern methods of garbage and waste disposal.

Sanitary land fill dumps, if properly operated, are acceptable, but open dumps should be abolished. Similarly, all open burning of every kind should be prohibited, except in most unusual circumstances and then only after a permit to carry out the open burning has been obtained from the Commission.

Incineration at its best is never completely satisfactory from an air pollution standpoint and should be discouraged in favour of other more acceptable disposal methods. Incineration at its worst is an absolute abomination.

A well engineered municipal incinerator, designed to handle the load it is required to consume, should be able, provided it is equipped with efficient effluent scrubbers, to satisfy the requirements of most existing air pollution control codes. However, although such an incinerator may achieve almost complete combustion, 20% to 25% of the ash will be emitted from the combustion chambers, and up to 15% of the ash will even pass through the scrubbers and out into the atmosphere. Scientific tests made on good municipal incinerators, using the best available type of collectors, have disclosed that as many as twenty thousand billion microscopic particles of dust, fume and vapour are emitted to the atmosphere per ton of refuse burned. Therefore, in the opinion of this Committee, whenever it is possible, municipal incinerators should be replaced by some other, more advanced method of garbage disposal.

We have seen efficient industrial incinerators, especially designed and professionally operated to handle dry industrial wastes, do an acceptable job of disposing of the waste without creating an objectionable local air pollution nuisance.

However, domestic incineration is incineration at its worst. No home incineration of waste or garbage should be allowed and the domestic incinerator in any form should be prohibited.

Most apartment house incinerators are far from satisfactory. All flue-fed incinerators should be illegal. For larger apartment houses where there is a sufficient number of apartment units to justify the expense of an incinerator equipped with a secondary combustion chamber, auxiliary burners, effluent

scrubbers, etc., then the burning of dry refuse could be permitted. It is very likely, however, that this privilege would be abused and that wet garbage would be inserted more or less frequently. When one considers that it takes good equipment and a trained operator to properly burn, without significant air pollution, furnace fuels of fairly uniform and consistent composition, it is easy to realize how impossible it is to adequately consume and control the air pollution from a variable fuel such as garbage, in which the extremes of moisture content may be from 5% to 95%, and with the volume and composition of the charge varying from day to day, and season to season.

It is our opinion that all incineration should be prohibited wherever it is reasonably possible to do so. We recommend that alternative methods of garbage removal and disposal should be thoroughly investigated by the proposed Commission. For example, there are in use in New York, Pittsburgh and at least twenty-five other large municipalities on this continent modern, efficient, sanitary, high capacity, completely covered, mechanical garbage pick-up systems, which require only one man to operate each pick-up unit. Such a system could well replace apartment house incinerators.

A modern garbage disposal method which should be considered for future planning is that of sewage disposal plant treatment of garbage. If the garbage is ground up in individual home garbage grinders, it is transported through the municipal sewerage mains to the sewage treatment plant. Some municipalities, which do not have sufficient sewer capacity for this purpose, collect the garbage in trucks and then grind it in large municipal garbage grinders before feeding it into the sewage treatment plants.

Composting appears to this Committee to be the most promising method of garbage and waste disposal. We believe that machine composting will ultimately prove to be by far the most economical and the least troublesome system. It is indeed improvident to bury our garbage in the ground, attempt to sink it under the waves, or burn part of it and bury that part which is neither burnt nor thrown out into the air, when the garbage is needed and can be utilized as fertilizer and a conditioner for the soil.

Garbage and waste disposal is certainly a subject which will require the serious consideration of the proposed Commission. Methods of disposal are still being used in many places today which are no improvement over those employed centuries ago.

(C) OTHER FINDINGS AND RECOMMENDATIONS DEMANDING SERIOUS ATTENTION

The general aspects, effects and implications of air pollution were covered in a brief manner in our Interim Report and we do not propose to unnecessarily expand this Final Report by the repetition of information contained in Appendix

"A". However, some of the facts, because of their great importance, deserve the emphasis of reiteration. These facts, plus some other findings and recommendations demanding attention, follow.

6. THAT THE INTERNAL COMBUSTION ENGINE IS ONE MAJOR SOURCE OF AIR POLLUTION WHICH MUST BE CONTROLLED AS SOON AS POSSIBLE.

The Committee wishes to state again what we said in our Interim Report concerning internal combustion engines burning gasoline and oil. They are definitely a major source of air pollution and should be controlled as soon as this can feasibly be done. In this category we include not only gasoline powered automobiles, but also diesel busses, railway engines and diesel powered equipment of all kinds.

Motor vehicle registration in Ontario is increasing by about 100,000 cars per year. At this rate, we may expect the concentration of automobiles in our larger cities to reach a critical level within the next five years, or sooner. By "critical level" we mean that concentration which will produce sufficient air pollution to be frequently and obviously irritating to average people on days when there is a lack of atmosphere cleansing air movement.

The hydrocarbon-oxidant-nitrogen oxide effects directly attributable to automobile exhausts include irritation of the mucous membranes and other health damage, reduced visibility, injury to vegetation and deterioration of rubber and probably other materials.

The problem of reducing hydrocarbon emissions from gasoline engines may be attacked in two different ways. Firstly, by attempting to obtain complete combustion of a greater percentage of the fuel entering the engine, and, secondly, by trying to burn in the exhaust system whatever fuel and partly burned hydrocarbons get through the motor.

By far the greatest percentage of fuel waste occurs when the motor is decelerating. Therefore, the major automobile companies have, for almost two years, been pooling their research facilities, brains and money in a concerted effort to develop manifold vacuum controls and fuel intake controls which will effectively eliminate much of the fuel wastage, particularly in the deceleration phase of the driving cycle.

Research is also being done by other companies on catalytic mufflers and on fuel after-burners, both of which devices would be designed to burn to harmless carbon dioxide and water any unburnt fuel, partially burnt hydrocarbons and carbon monoxide which manage to pass through the engine, before they could escape into the atmosphere.

Both types of control are important. It is most improbable that fuel intake and vacuum controls will be able to achieve an improvement in the exhaust of more than 60%. Such a reduction in the output of contaminants would, of course, be important for several reasons, one of which is that it would probably appreciably extend the useful life of any catalyst employed in a muffler type of control. It is clear, that if anything approaching 100% efficiency in the cleaning up of automobile exhaust is to be achieved, a muffler afterburner of some type will be necessary in addition to any controls which may be incorporated in the motor itself.

Without any controls, automobile exhaust fumes include the following air contaminants, which react in the atmosphere, in the presence of sunlight, to form still other additional compounds which, in their own right, are irritating to the body and damaging to materials: unburned gasoline, nitrogen, oxides of nitrogen, carbon monoxide, argon, hydrogen, methane, ethane, ethene, several compounds of the paraffin series and several of the olefin series of chemicals, organic acids, benzene and other aromatic compounds. Fuels which contain sulphur, as many brands of gasoline do, also produce oxides of sulphur.

The air pollution caused by diesel engines differs from that produced by gasoline motors. One main defect with a gasoline engine from an air pollution standpoint is that of incomplete combustion, because of lack of sufficient oxygen in the cylinders. The diesel engine, on the other hand, operates with an excess supply of air. As a result, the amount of carbon monoxide emitted from a diesel is much less than that from a gasoline motor and also a much smaller percentage of unburned fuel escapes in a diesel exhaust.

There are several types of diesel motors and with each variety there is a different, fairly characteristic exhaust. However, generally speaking, all diesels do emit aldehydes and some oily smoke which are very noticeable under certain conditions. The aldehydes have a pungent odour and cause eye, nose and throat smarting, and produce nausea in many people. In addition to aldehydes, the other air contaminants from diesels include methane, nitrogen, oxides of nitrogen, and also oxides of sulphur, depending upon the sulphur content of the fuel used.

Experts agree that a large part of the air pollution problem caused by diesel engines can be attributed to inferior grades of fuel oil being used by the operator to save money, and to maladjustment of the engine, which is said frequently to be intentional.

We have tried to eliminate statistics and scientific data from this report, but in order that the Honourable Members will realize quite clearly the situation in Ontario with regard to air pollution from vehicles and what they may expect from this source in the not too distant future, we wish to present the following figures for your consideration:

ONTARIO MOTOR VEHICLE REGISTRATION

Year	Ontario Population	Total Vehicle Registration (Including commercial vehicles and motorcycles, but not including trailer permits.)	Ownership Ratios		Gross Fuel Sales for Internal Combustion Engines (Imperial Gallons)
			(a) Persons per Vehicle	(b) Vehicles per 1,000 Persons	
1915	2,724,000	46,520	64.4	17	
1925	3,103,000	342,174	9.2	110	
1935	3,575,000	564,076	6.4	158	272,680,687
1945	4,000,000	662,719	6.1	165	323,814,957
1955	5,016,000	1,617,853	3.1	322	1,099,962,376
Projection					
1956	5,250,000	1,708,040	3.0	325	
1960	5,820,000	2,124,000	2.8	365	
1965	6,500,000	2,790,000	2.4	429	
1970	7,280,000	3,477,000	2.1	477	

The estimated total motor vehicle registration of 1,708,040 for Ontario for 1956 is broken down as follows:

Passenger Cars	1,363,900
Commercial Vehicles (including 4,279 busses)	297,200
Dual Purpose Vehicles (station wagons, etc.)	35,300
Motorcycles	11,640

TOTAL MOTOR VEHICLE REGISTRATION AND CONCENTRATION FOR YORK COUNTY AND METROPOLITAN TORONTO FOR 1955

1. **York County** (population 113,289), **444,603** (of which 73,819 are commercial vehicles.) For York County the ownership ratio for 1955 was 2.5 persons per vehicle, or 393 vehicles per 1,000 population.

Estimated figures for 1956 indicate a probable ownership ratio of 2.3 persons per vehicle or 440 vehicles per 1,000 population.

2. **Metropolitan Toronto** (population 1,250,772), **396,999** (of which 63,714 are commercial vehicles). The ownership ratio for the metropolitan area is 3.2 persons per vehicle, or 316 vehicles per 1,000 population.

Actual traffic counts show that 88,650 vehicles now enter and leave the downtown Toronto area during an average week day. This figure does not include the lakeshore and the other traffic which by-passes the downtown area, nor does it take into account the automobiles which are left in the parking lots on the waterfront. This daily influx of cars brings the average effective downtown Toronto vehicle concentration up far above the 316 vehicles per 1,000 population which the registration and population figures, by themselves, indicate.

Based upon experience elsewhere, we may say that persons most sensitive to air pollution may expect to feel the effects of air pollution from automobiles when the concentration of vehicles in an urban area becomes greater than about 400 cars per 1,000 population. The average person will likely suffer discomfort frequently when the level reaches about 450 cars per 1,000 popula-

tion. We believe that all of us are adversely affected, without consciously realizing it, by the exhausts produced by concentrations of vehicles much lower than 400 per 1,000 people.

In view of this and based on the expected increase in motor vehicle registration, Toronto citizens may anticipate experiencing episodes of eye smarting and throat, nose and skin irritation before too many years have passed, if nothing is done to control air pollution from cars, trucks, busses and motorcycles. It is probable that similar instances will also occur in other Ontario cities with a frequency that will increase with the number of vehicles on our streets and highways. In fact, already, occasional incidents of eye smarting and watering have been reported to us from not a few Ontario city dwellers.

In 1955, the total gross fuel sales for internal combustion engines for all of the Provinces in Canada totalled 2,902,470,607 Imperial Gallons. Of that total, Ontario consumed 1,099,962,376 gallons. Ontario, then, is burning up almost 40% of the gasoline and diesel fuel used in the entire country.

Research workers have discovered that for every gallon of gasoline burned in the modern automobile engine there is discharged into the atmosphere some seventy-five thousand billion particles of matter. You cannot see these because each particle is about one-millionth of an inch in diameter, or less. However, since these particles are so minute they can penetrate deep into the alveolar air cells of the lungs, where many are retained by the body to its detriment.

THEREFORE, WE STRONGLY RECOMMEND TO THE PROPOSED AIR POLLUTION CONTROL COMMISSION THAT AS SOON AS EFFECTIVE AND PRACTICAL DEVICES ARE DEVELOPED AND MADE AVAILABLE TO IMPROVE THE QUALITY OF AUTOMOBILE EXHAUST, THEIR ATTACHMENT SHOULD BE MADE MANDATORY ON EVERY GASOLINE POWERED MOTOR VEHICLE IN ONTARIO. Similarly, when available, we recommend the use of vapour recovery and other control devices for preventing hydrocarbon losses to the atmosphere in filling the gas tank and during other marketing operations.

And, in the meantime, we further recommend that the Commission investigate the possibilities, which to us appear most promising, of adapting diesel and gasoline busses to burn propane for fuel. There is some expense involved in the conversion process, but we understand that operation with propane can be more economical than when either gasoline or oil is used as a fuel. The important point is that the exhaust from propane is much less offensive.

The Commission should also investigate the use of catalytic mufflers for diesel equipment as a possible alternative solution for city busses, and for use on diesel trucks and railway engines. Such mufflers are now operating on

certain diesel equipment being used in mines and other confined quarters. When diesel muffler exhaust controls are considered by the Commission to be practical for use on our roads and available in sufficient numbers, the Commission should give consideration to making their use mandatory on all diesel powered vehicles and other diesel equipment being operated in Ontario.

As a suggestion of the unforeseen future air pollution control problems which our quickly advancing technology will create, it is interesting to note that a scientist of the Air Weather Service at Washington, D.C., has investigated the effects of aircraft exhaust on airport visibility. He has found that under certain weather conditions, (very light or no winds, and high relative humidities), the smoke particles and hygroscopic nuclei in the exhaust of aircraft can produce "serious deterioration of the weather, especially visibility, over an airfield." It is stated that jet aircraft engines, especially, are very inefficient at low altitudes and therefore emit great amounts of exhaust gases while flying around an air field awaiting the signal that it is safe to land, and in the process of landing and taking off.

It is possible that this air pollution from planes might already be of some significance in those accidents which result directly or indirectly from poor visibility around airports. With the steadily increasing volume of air travel, the air pollution problem created by large numbers of takeoffs and landings could well turn out to be a matter in which the experts of the proposed Commission could be of valuable assistance in the future.

7. THAT AIR POLLUTION IS A VERY REAL PROBLEM FOR THE FARMER AND HE WOULD BE WISE TO TAKE AN ACTIVE INTEREST IN ITS CONTROL.

The individual who resides in a rural part of the province should not assume that he is free of the burden of air pollution merely because he lives in the country. He, like his city brother, pays in more ways than one for air pollution. For him, too, it is much cheaper to enjoy clean air. And, in case he believes that the air over his farm is not polluted, he must remember that the atmosphere can look very clean and clear and still be carrying tons of air contaminants across his property every day.

(a) CROPS

The farmer should also keep in mind that his crops do not have to be destroyed by an obvious attack of concentrated air contaminants, although, of course, this has happened in many places on occasion. We wish to remind him that he can, and probably does, suffer a steady, insidious loss, which is increasing year after year, because of the "imperceptible damage" caused to his crops by air pollution. This means that his plants and their fruits are smaller,

and of inferior quality, but otherwise appear quite normal. There is a diminution in size of his peaches, apples, ears of corn, berries, kernels of grain, cabbages, radishes, spinach leaves, squash, turnips, cucumbers, tomatoes and whatever else he grows, from the size they should be if they had pure air to grow in. We have seen proof that this does happen and the farmer never suspects the loss he is taking until it is pointed out to him.

On the other hand, although the crop may not get smaller in the size of the individual fruit, vegetable or kernel, it may decrease in numbers because the blossoms may have a lessened ability to fertilize their own species. Therefore, next year, the apples may be just as large as they were this, but there may be fewer on the tree.

Air pollution may also damage the surface of a crop with cracks, dead tissue and other blemishes which are frequently blamed on blight, or parasites. Such surface damage causes the market value of the produce to be greatly lowered. Certain spinach farmers, for example, have been put right out of business because of air pollution surface blemishes and for no other reason. In fact, many farmers cultivating various types of crops in different localities have had to stop their farming activities because of losses mounting each year caused by steadily increasing air pollution from growing cities and automobile traffic.

Although it has been known for at least a century that air pollution damages vegetation, it is only recently that the problem has reached severe proportions so far as the farmer is concerned. It used to be thought that the principal phytotoxicants were sulphur dioxide and the halogens. However, during the past ten years new airborne plant poisons have appeared in the atmosphere. Damage to vegetation by the "oxidants" was only discovered during the past decade, and in the vicinity of many large cities it did not make its appearance before 1950, or even as late as 1952. We must face the fact that oxidants are now with us, and that their intensity will increase and the damage they produce will extend from the cities in ever expanding circles into the surrounding countryside.

One example will suffice to illustrate the rate at which air pollution damage to farming is increasing. In 1949, the crop losses caused by air pollution in a certain county in the United States were estimated at approximately \$480,000. By 1953, the air pollution damage to crops in the identical area had exceeded \$3,000,000. Since 1953, many farmers in that district have been forced either to give up their profession, or to purchase new farming land in much more remote localities.

Above, we mentioned that the fruit may be of inferior quality because of air contamination. That statement includes the nutritive value of the fruit. It has been shown, for example, that certain fruits actually contain less Vitamin C when they are grown in air contaminated with city air pollution than do those

which are grown under identical conditions except that the air has been kept really clean. Therefore, air pollution can have a detrimental effect on the food value of a crop.

Hence, it is time for every Ontario farmer to take careful inventory. It may be that his fruit is of a smaller size than it used to be in past years. Its food value may be poorer than should be. Its appearance may be marred by cracks or other blemishes. The number of units in his crop may be less than it should be. Depending upon the individual contaminant components of the air pollution in his district, the farmer might suffer any of these losses, or it is a distinct possibility that he may be suffering from all four of them.

Automobile exhaust, with ozone in the atmosphere, has been shown to damage spinach, oats, beets, Brussels sprouts, peas, wheat, peaches, alfalfa and many other plants, even when the exhaust is first diluted with clean air 1 part in 116. The more numerous and better the highways of our province become, the resultant steadily increasing influx of automobiles and trucks through the countryside will deliver right to the farmer's front door, more and more of the internal combustion engine type of air pollution. That is, they will, unless he is willing to support an effective air pollution control authority in Ontario to solve these problems before they become too stupendous to be tackled, with any apparent effect, in our time.

Without attempting to make an exhaustive list, we wish to enumerate some crops of interest to Ontario farmers which have been proven, without a doubt, to be susceptible to air pollution damage. Some plants are damaged more by one particular air contaminant than by others. Some are relatively resistant to damage caused by a pollutant which may be devastating to the health of other varieties. But all of these crops grown in Ontario can be spoiled in some way or another by typical air pollutants:

Alfalfa, barley, buckwheat, clover, corn, flax, maize, oats, rye, wheat and many types of grasses; beans (many varieties), beets (table and sugar), broccoli, cabbage, carrots, cauliflower, celery, Chinese cabbage, cucumbers, eggplant, endive, kale, leek, lettuce, onion, parsley, parsnips, peas, potatoes (plain and sweet), pumpkin, radish, rhubarb, spinach, squash, Swiss chard, tomato, turnip, tobacco; apple, apricot, cherry, peach, plum, prune; blueberry, gooseberry, grape, raspberry, and strawberry.

As an example, air pollution injuries to beet leaves can seriously interfere with the essential life processes of the plant, (e.g. photosynthesis and respiration), before they look bad enough to alarm the average farmer. As a result the beet itself, under the ground, cannot develop properly in size or in quality. In addition, such beet leaves, when exposed to automobile exhaust gases, have their cell membrane permeability disrupted. Consequently, when the leaves are wet by rain, or water from any source, the anthocyanin pigment and

other plant elements diffuse out, are washed away with the water and are lost to the plant.

Trees damaged by air pollutants include birch, elm, hawthorne, larch, maple, mountain ash, mulberry, pine, poplar, sycamore and willow.

The flowers which may be injured by air pollution range through practically every variety from the hardy petunia to the delicate orchid. The orchid growers of the Hawaiian Islands, for example, have already become conscious of the great losses they are suffering, and they are now making a determined, united effort to have something done to curb the air pollution from their cities which is spoiling their orchid crops.

On evidence presented to us by university professors and other highly trained, agricultural specialist scientists, this Committee is satisfied that many crop failures, which have been attributed to poor soil, drought or too much rain, to lack of aeration or proper fertilization, to plant parasites, mosaics or other diseases, or to some combination of these factors, were and are caused entirely, or to a great extent, by air pollution.

Therefore, it behooves our farmers to consider these facts. The farmer uses good seed, applies fertilizer, irrigates when necessary, rotates his crops, sprays them to kill insects and prevent diseases and does many other things to try to ensure a reasonable profit from his labours. Nevertheless, his produce does not bring as good prices as it should. The one factor concerned with production about which he has done absolutely nothing is air pollution. That may well be THE important factor which is eating up a large portion of the profits which should rightfully be his.

(b) LIVESTOCK

There is also, in our opinion, more than ample evidence to prove that farm livestock can be and are injured every year by air pollution. This again, of course, affects the income obtained by the farmer for his work.

Air pollution damage to human health is principally the result of the breathing of air contaminants. However, with animals and fowl, although inhalation undoubtedly does affect them as it does humans, health troubles are mainly caused because of the livestock eating forage which has been contaminated by some kind of air pollution. Some airborne poisons can be accumulated by the vegetation in its fibres as well as on its surfaces. As the result of ingestion, almost 100% of the contaminant eaten with food by the livestock may be retained in the animal's body. Also, certain poisons are cumulative in the animal's system when there are repeated exposures to less than toxic doses. Hence, the repeated daily ingestion of minute amounts of certain pollutants will

ultimately produce the effect of one large toxic dose. Because of all these factors, the health of livestock can be damaged by much smaller concentrations of some air contaminants in the atmosphere than will produce noticeable effects on humans.

This is an extremely complex subject, but let us, for illustration, try to oversimplify it by mentioning a few facts about one possible type of air contaminant, namely, fluorine and fluorides. The industrial hygienists have established what the maximum allowable concentrations, (M.A.C.), should be for fluorine and fluorides in the air which a working man may breathe for eight hours every working day without any injury to his health. On the other hand, concentrations which are very much smaller than the so-called "safe" M.A.C. levels for humans, when present day after day in the air over a farm, can produce an accumulation of contaminant, or of contaminant products, in the vegetable tissues of forage which is above the critical toxic threshold amount for livestock food. Eating such vegetation will result in damage to the health of the livestock, the severity of which will vary with the amount of the toxicant in the forage above the toxic threshold level, and the duration of the exposure, or the number of repeated exposures, of the livestock to the poisoned forage. Of course, the situation will be aggravated when the air pollutants also contaminate the drinking water consumed by the livestock.

One other complication might be mentioned which partly explains why some species of livestock are more susceptible to health damage from certain specific air contamination than others. The toxic effect of different fluorides depends upon the amount of the particular fluoride which goes into solution in the body fluids of the animal. Sodium fluoride is very soluble compared to some other fluorides which are relatively insoluble. In the cow, however, the saliva contains sodium bicarbonate in amounts sufficient to convert other fluorides to sodium fluoride. This fact makes the cow more susceptible to fluoride poisoning from air pollution than, for example, pigs or chickens.

Incidentally, fluorine is regarded as the probable chemical cause of the deaths from smog in the Belgian disaster in the Meuse Valley. In this case, the poison was carried with the smoke from a number of factories and, of course, animals as well as humans died.

It used to be thought that fluoride air contamination occurred only in the neighbourhood of aluminum manufacturing companies. However, we now know that measurable amounts of fluorides can be detected in the air over any large coal burning city, and that they are also given off in the manufacture of many things other than aluminum, e.g. clay bricks, phosphate chemicals, steel, fertilizers, etc. Therefore, this contaminant may well be originating within wind-carrying distance of almost any farm in this province.

There are two other important points for the farmer to remember. Some air contaminants are able to pass through the placental membranes to affect the fetus, and others are secreted in the milk, where they can cause injury to the health and normal growth of the young animals.

There will not be sufficient space in this report to give detailed consideration to each known air contaminant, but we wish to merely list some of the effects which have been shown to occur in farm livestock as the sole result of air pollution. Air pollution has been proven to be detrimental to cattle, horses, sheep, swine, rabbits and other animals and poultry.

The following health defects have been clearly demonstrated in farm livestock as the direct result of air pollution over farms: anaemia and diseases of the blood forming organs, with a resultant lethargy and loss of desire to forage for food; inflammation of the respiratory system and chronic cough; feeble pulse and respiration; gastric upsets and inflammation of the whole gastro-intestinal tract resulting in colic attacks, intermittent diarrhoea, loss of appetite, vomiting, excessive thirst, and leading to weight loss, emaciation and even on to severe cachexia and death; loss of hair or fur, chronic eczema and other skin troubles; abortion and sterility, nervousness, staggering, inability to rise and stand, and even paralysis of the limbs; calcification of ligaments and joints, lameness, arthritis, exostoses, osteomalacia and other types of bone, joint and rheumatic disease. The animal may find that its neck and other joints are so painful that it is loathe to bend over to eat.

Also, dental disease and decay, plus ulcers around the nose and gums contribute to the painfulness of attempting to eat. This results in a self-imposed starvation which produces general malaise and malnutrition in the animal. This malnutrition retards the normal growth of younger animals, spoils the milk production of adults, and causes increased lethargy, nervousness, stiffness and exhaustion. In extreme cases, paralysis may occur in the larynx and breathing muscles, and abscess can develop in the lungs.

In general, it may be said that air pollution can damage every part of the anatomy and physiology of the animal: its liver, stomach, intestines, kidneys, respiratory system, heart, red blood cells and the blood forming organs, nervous system, bones and joints, teeth, mucous membranes and skin.

Therefore, the farmer should look carefully at his livestock. If the farm animals are undernourished he should consider the cause. It may be that they are suffering from air pollution anorexia. Or, perhaps they have arthritic and other changes which make it a painful effort for them to bend down and to eat. Undernourishment means less milk and cheese, less meat to sell, less food for the young animals and greater susceptibility to many infective and degenerative diseases which will cause even greater losses for the farmer.

(c) FARM BUILDINGS AND EQUIPMENT

In addition to what we have said above about farm air pollution losses, we should point out that the farmer also has to pay a share of the money which is being wasted in the cities by the concentrated air pollution which exists there. The high cost of urban air pollution must be reflected in increased prices of the city-made products which the farmer buys.

We would also like to remind the farmer that masses of polluted atmosphere are frequently carried by air currents many, many miles from their sources. Occasional astounding examples of this have been recorded by meteorologists in several countries. These so-called "freak" episodes have forced themselves upon the attention of the public and the scientists only because of the conspicuous and consciously disturbing nature of the particular pollutants which were involved. The same type of air transportation of invisible air contaminants undoubtedly occurs very frequently, if not almost constantly, but passes unnoticed.

A few examples of the "freak" occurrences of this nature are:

Dust originating in the United States, even from as far south as Texas, has, on occasion, blown over Ontario and has been washed out of the air here, by rain. Such conditions produce a dirty downfall which splashes mud over faces, clothing, cars, buildings, windows and streets.

In 1950, a cloud of smoke averaging 250 to 300 miles in width travelled from Alberta forest fires across northern Europe. As this cloud darkened Toronto, light switches were turned on, and even though it was a Sunday afternoon and therefore few industries were involved, nevertheless, 180,000 kilowatt-hours were added to the Toronto electric accounts. Street lights were required in Buffalo, N.Y., and other municipalities, and floodlights had to be turned on for afternoon sports events in Cleveland, Ohio; Detroit, Michigan and elsewhere.

When University of Wisconsin professors investigated a fall of reddish-brown snow which occurred in Wisconsin, they discovered, from analysis of dust, rock, plant material and microscopic living organisms contained in the snow, that the pollution had originated in Arizona and New Mexico, a thousand or more miles away from where it fell to earth. Simultaneously, a similar fallout was reported in Vermont and in Northern Michigan. Analysis and calculations indicated that at least a million tons of rock and dust had fallen in Wisconsin in the coloured snow. This incident of the red snow caused the Wisconsin professors to conclude that the total work done by air in altering the topography of the world is as great as that done by water. They went so far as to suggest that most of the topsoil of the midwest region of the United States was deposited by the air. They commented that water transports sand and gravel down streams, washes away hillsides, and cuts gullies. Its work is easily seen on every hand. In contrast, air transports much finer material, and its work is rarely noticed; yet the air is constantly acting over a much larger surface than is affected by water, and the results of its work on the land surface are probably just as important as the results of water action.

Going back to 1883, the famous Krakatoa volcanic eruption of that year produced dust and ash which remained suspended long enough to lower temperatures over the northern hemisphere of the earth, by 10% or more below the normal, for three years after the explosion. It required three months for this great dust pall to move from its source in the Dutch East Indies to Europe. When it arrived over France, the sun's radiant energy, as recorded on instruments at the Montpellier Observatory, dropped suddenly from 30% above normal to 20% below normal. Similarly, in 1912, the eruption of the Katmai Volcano in the Aleutian Islands brought about a 20% reduction of the sun's radiation in Algeria, many thousands of miles away. Many other examples could be cited to illustrate how far air contaminants can travel and how long they may remain suspended in the atmosphere.

Incidentally, investigation has shown that while air pollution can block much of the sun's energy from reaching the earth, it does not hold down the longer heat waves which are radiated back up from the ground. Thus it permits the earth to cool off, aggravating the effect of any temperature inversion which may exist in the area. By increasing temperature differences between different regions of the world, large masses of air pollution can conceivably cause acceleration of air circulation currents and produce cold, stormy winters and cloudy, cool, wet summers.

However, the main point we wish to make is this. If relatively heavy materials like mud, volcanic ash and rock can be carried so many miles and can be kept suspended in the atmosphere for such lengths of time to be later deposited far from their sources, then, certainly, light invisible gases can also travel very great distances on the air currents to come to earth almost anywhere to injure the health of people, animals and plants, and to corrode and discolour buildings, equipment and materials.

We are of the opinion that, in many rural localities, air contaminants appreciably shorten the useful life of farm buildings, equipment, machinery and fences. This requires the farmer to spend money to purchase replacements much sooner than he should, were the air clean and pure.

As an example of this farm deterioration caused by air pollution, permit us to cite one of the simple tests we made. From one of the Ontario farms which the Committee visited we secured samples of wire from a two-year-old fence. These wires were subjected to analysis by X-ray diffraction.

A piece of wire from the lowest part of the fence which was protected by long, wet grass showed what might be considered the usual amount of "normal" outdoor rusting. However, the wire taken from the top of the fence, which was completely exposed to the atmosphere and to no other apparent source of contamination, showed a markedly greater amount of corrosion, and a pitting which was not present in the bottom wire. Also the changes which had occurred in the top wire differed both chemically and physically from those which were found in the bottom sample.

This presumptive evidence satisfied us that the parts of that particular farmer's fence which are exposed to the air are being corroded by something

carried in the air of that district and thereby the normal, expected life of the fence is being appreciably shortened. This, and other evidence we saw on our tours of Ontario farms, has convinced us that here is a subject on which research work should be started without delay in order that the exact cause, or causes, of such abnormal and extensive corrosion of farm equipment may be determined and stopped as soon as possible.

To summarize, we believe that air pollution contributes in a substantial degree to crop failures and losses, to malnutrition and diseases in livestock, to reduction in milk, cheese and meat supply and to the premature deterioration of farm buildings, machinery and other equipment. Air pollution, therefore, is certainly a very real problem to the farmer, and a matter to which he should give his immediate and serious attention.

8. AIR POLLUTION IS A SERIOUS HEALTH HAZARD.

We are convinced that air pollution is always injurious to health in some way, to a greater or lesser extent depending upon the severity of the pollution. The health damage may be physical or mental, or both. When the pollution is relatively mild, the health effects may only amount to an anaemia-like "tired feeling", and a loss of desire to do a good day's work, or enjoy an evening's recreation. When the air contaminants present are of a more toxic nature and their duration in one region is long enough to permit photochemical oxidation, polymerization of hydrocarbons and other inter-reactions to occur in the atmosphere, the results can be most serious.

The reasons why (e.g. a temperature inversion) air pollutants are imprisoned, do accumulate, and react chemically in the atmosphere over an area are explained in simple terms in Appendix "A".

The effects of air pollution on health may range through a spectrum of disease from mental depression and a loss of normal vitality and efficiency, through headaches, "chronic bronchitis", sinusitis, rhinitis, asthma and other allergic manifestations, to cancer and death. When pollution is very severe, and under very unfavourable weather conditions, we know it can be quickly fatal in its results.

We are equally satisfied in our own minds, that under less critical circumstances it acts as a life shortener in more ways than one.

We believe that there is ample authority and a continually increasing amount of evidence to justify the statement that air pollution is a major cause of lung cancer and other malignancies. The Ontario statistics, on which we based the statements made in this connection about several of our cities in our Interim Report, strongly suggest this conclusion. Additional data collected since then only supplies more support for it.

Of course, there are many factors to be considered when rural and urban populations are compared, but it is, in our opinion, air pollution which is one of the principal reasons for the greater incidence of respiratory cancers, and

many other diseases, in the more thickly populated centres as compared with rural areas.

It has been established, in many cases, that the loss of normal visibility produced by air pollution has been the cause of accidents to vehicles, ships and aircraft. We are of the opinion that in addition to this loss of visibility, air pollution can and does make other significant contributions to our steadily mounting accident toll.

For example, a consideration of the single contaminant, carbon monoxide,* alone, provides presumptive evidence to indicate that the air pollution inhaled by the city automobile driver of today is sufficiently severe to impair his driving abilities. We believe that research should be undertaken immediately to determine to what extent road and highway air pollution is interfering with the driver's reaction time and his ability to make quick decisions.

Air pollution is a burden to all, but it is particularly oppressive to infants, the aged and to all those suffering from heart and respiratory diseases. It fosters illness by spreading carcinogenic chemicals, allergens and bacteria, and by filtering out a very significant percentage (frequently more than 50%) of the sun's bacteria-killing, air purifying and health giving rays.

It is well established that infants are among the first to die in lethally severe smog episodes. We are of the opinion that the chronic levels of air pollution over our cities should be investigated as a cause of infant mortality. We believe that air contaminants are well worth considering as one of the reasons why the infant mortality rates of a province, which is so advanced in most aspects of public health as Ontario, continue to remain appreciably higher than the corresponding rates of a few other countries where air pollution is no significant problem because of electrified railways and a predominantly agricultural rather than an industrial economy.

With regard to smoking, it has been estimated, as the result of a scientific study of the effects on air pollution of cigarette smoking, that the smoking members of a population the size of Ontario's will throw into the air more than 12 tons of contaminants per day. Each smoker adds to his intake of carbon monoxide by smoking, and, in other ways, he seriously increases his own personal air pollution problem and hence multiplies his chances of developing lung cancer. Unfortunately, circumstances frequently force the non-smoker to also inhale the second-hand smoke of others to the detriment of his health as well.

At present, we believe there is no health hazard from the fallout of Strontium 90, or any other radioactive element. However, this is a type of air pollution which could conceivably reach a dangerous level in the future. Therefore, the proposed Air Pollution Control Commission should have personnel qualified to give continuous attention to radioactivity in the atmosphere of Ontario, and to developments in atomic energy as they, in the future, may be applied to power stations, industry, locomotion and defence purposes.

*See Appendix "D"

We do not wish to go into great detail concerning the many possible hazards to health and safety produced by the multitude of air pollutants which are, or could be, in our atmosphere. Volumes could be written on this subject and, of course, a great amount of research still remains to be done. It is sufficient to say that dust fall samples taken in our major cities prove that hundreds of tons of dust, soot, fly-ash, metallic oxides, and organic matter of various kinds, fall on each square mile every year. For every ton of air pollutants that falls, and is actually measured in these dust fall studies, there is at least a like amount of other contaminants which remains suspended in the atmosphere in particles small enough to be inhaled deep into the lungs. In one city there have been identified over 50 different elements and compounds which help to compose the air pollution of that municipality. Other substances still await identification.

In Appendix "D", we have briefly mentioned the effects of just three well known and common air contaminants in order to suggest the seriousness of the health aspect of this problem of air pollution.

9. THAT AIR POLLUTION CONTROL IS AN IMPORTANT JOB WORTHY OF THE ATTENTION AND ABILITIES OF LEADERS IN BUSINESS, INDUSTRY, SCIENCE AND GOVERNMENT.

Air pollution requires the attention of top executives in industry and business. It merits the same level of management control as processing, production, development and sales. We are encouraged to discover that some of the more progressive industries in Ontario have realized this on their own.

However, we are sorry to find that many companies, up to the present, have given little or no thought to air pollution and its control. We ask the officials of these companies to make an honest and socially conscious appraisal of the problem and the extent of their contribution to it. We wish them to frankly consider, not merely the immediate expense which may be involved in the controlling of their air pollution, but the serious effects it is having on themselves, on their families and on all of our people, and the great future benefits we will all enjoy when control is achieved generally throughout our province.

The attitude of modern business management was expressed back in 1952 at the Second National Air Pollution Symposium by Henry du Pont in his paper "Management Looks at Air Pollution." At that time Mr. du Pont stated:

"Our top management policy is to insist, before approval of a project is given, that all air pollution problems be solved in advance. . . ."

This statement of policy from such an outstanding industrialist indicates clearly to our Committee that top management, which has taken the trouble to thoroughly study air pollution, has proven to itself that it can always save money by properly planning for air pollution control in the blueprint stage of its undertakings.

Likewise, air pollution control is of vital importance to the leaders of government. This statement is particularly true with regard to municipal government. For those municipalities which are large enough to have municipal air

pollution control personnel in their employ, these employees should be organized as a department responsible directly to the municipal council.

Air pollution costs each municipality money, and this makes the municipal tax rate greater than need be. Air pollution helps to create slums and aggravates existing slum problems. It also causes a progressive decrease in property values and in the resulting assessments. The loss in municipal taxes which can be directly attributed to air pollution is appalling.

Therefore, municipalities should not neglect to control the smoke from schools and other municipal buildings. In fact, public buildings owned and operated by all levels of government have to be subjected to the same rigid air pollution control that industry and business must exercise. All smoke is an evidence of waste, and we wish to state again that the techniques for controlling plain, ordinary smoke have been mastered elsewhere in the world. Therefore, smoke should be no great problem in Ontario. It can be eliminated almost completely, if we wish to take the trouble and spend the money to eliminate it.

While most sources of smoke can be cleaned up by inspiring public spirited co-operation in the offender, the proposed Commission must have authority to impose effective penalties upon unco-operative persons.

As an example, in one Ontario municipality we saw several factories operating without the emission of any smoke. However, one plant in the area was continually conspicuous during our whole tour of the district because of the dense black smoke coming from its chimney. The officials of the clean, well mannered factories all stated that they had individually and together tried in vain to educate the management of their dirty neighbour in smoke control. When they pointed out how much fuel he was wasting in his inefficient operation, the manager's reply was: "So what; coal is cheap."

The old-fashioned idea was that a smoking chimney is a sign of full lunch pails and of prosperity. We are convinced that smoke does not prove prosperity. What it does show is ignorance, waste, and negligence or bad manners. It is a source of unnecessary dirt and work for the housewife. It may also be a sign of full hospital beds. We say again that it is neither polite nor proper to dump your garbage on your neighbour's property.

WHERE THERE'S SMOKE THERE'S FIRE, BUT WHERE THERE'S FIRE THERE NEED NOT BE SMOKE.

When we pass from the consideration of ordinary smoke to other more complex types of air pollution, we enter a field where the assistance of highly trained engineers and scientists of various sorts will be required.

We believe that there is, or there can be developed, an answer for practically every air pollution problem. We know that there will be the occasional industry which will present to its officers, and to the Commission, an extremely

difficult air pollution conundrum. We are of the opinion that the Commission should have staff members capable of investigating every such problem, or, at least, have the power to engage consulting specialists so that a solution will always be found for every difficulty. Such work demands the research skill of top ranking scientists.

We believe that air pollution control is worthy of the attention of, and is a challenge to the abilities of our leaders of the highest calibre in business, industry, science and government.

10. THAT THE MAJORITY OF THE DETAILS OF WAYS AND MEANS OF SECURING EFFECTIVE ENFORCEMENT OF AIR POLLUTION CONTROL CODES, RULES AND REGULATIONS SHOULD BE LEFT TO THE COMMON SENSE AND GOOD JUDGMENT OF THE PROPOSED AIR POLLUTION CONTROL COMMISSION—WITH SOME PRINCIPLES FOR GUIDANCE.

- (a) Members of the Commission should be non-partisan and chosen because of their sincere interest to obtain a cleaner, healthier atmosphere for all of our citizens. They should be fair in their thinking, impartial in their dealings and fearless in their decisions and prosecutions.
- (b) The impartiality of the Commission's decisions should soon make industry and others realize that the air pollution control effort is being carried on in good faith to do a necessary job thoroughly, for the good of all. To establish the confidence of industry, no rules should be imposed on one violator more than another in the same class of business. No company should be placed at a disadvantage with respect to its competitors because it is forced to invest money in air pollution control, while the competitors are permitted to do nothing in this regard. All sources of air pollution nuisances must abate just as soon as possible.
- (c) The Commission should have a staff of conscientious and competent experts who are qualified to understand the technical difficulties involved in each problem, and who will exercise a reasonable amount of patience with an industry which sincerely tries to co-operate and comply with the requirements of the Commission.
- (d) Every consideration should be shown to a violator with an unusually difficult technical or engineering problem to solve, so long as he, himself, is making a bona fide effort to find a solution. It is often better to permit an offending industry to work out its own solution for a technical dilemma if it has the qualified staff to enable it to do so. What is a bona fide effort will have to be a question of fact for the Commission to decide in each instance in which special consideration is requested. A certain attempt made by a small concern might be all that it can reasonably be expected to do without

substantial assistance; whereas the same amount of effort expended by a company with more capital and a larger and better qualified staff, could well be deemed inadequate to justify continued special consideration from the Commission.

- (e) The proposed Commission should probably require every industry which emits air contaminants, other than ordinary smoke, to register with the Commission the nature of each contaminant emitted, or which might be emitted to the atmosphere, the approximate percentage composition of the usual effluent and the average quantity of the total effluent. The modern trend in other progressive jurisdictions is to require such a registration to be made by industries with the control authority. The analysis in each case could be certified by a qualified scientist or a professional engineer.
- (f) Education, persuasion and technical assistance and advice should generally be employed by the Commission in the first instance to obtain compliance from a violator of good air pollution control practices.
- (g) If the violator is unco-operative, or only makes a pretence of being co-operative without demonstrating any actual and substantial progress in implementing the recommendations of the Commission or in preparing to comply with its codes, rules or the regulations, as the case may be, then the Commission should not hesitate to resort to the imposition of severe penalties, even to completely closing down the factory or other source of air contaminants. Other jurisdictions have already taken the attitude that they do not want any industry in their area which is not willing and able to comply with local air pollution control codes. We agree with this attitude completely.

11. THAT THERE IS A DEARTH OF PERSONNEL TRAINED IN THE SCIENCES AND TECHNOLOGY OF AIR POLLUTION INVESTIGATION AND CONTROL, THEREFORE THE PROPOSED COMMISSION SHOULD BE ESTABLISHED PROMPTLY AND AUTHORIZED TO START, FORTHWITH, RECRUITING AS MANY SUITABLE STAFF MEMBERS AS CAN BE ATTRACTED TO THE COMMISSION, AND TO BEGIN TRAINING AS MANY MORE AS ARE REQUIRED TO PROVIDE ADEQUATE SERVICE IN THIS FIELD FOR THE CITIZENS OF ONTARIO.

Some comments regarding the staff of the Commission might be helpful, and our suggestions on this subject follow:

- (a) **STAFF ORGANIZATION** of the Commission should be patterned somewhat after the enforcement agencies already existing in a few of the large centres of the world which have been proven necessary to cope with the problem.
- (b) **ENGINEERING** is a major factor in the control and abatement of air pollution. The design, maintenance and operation of equipment are important causes of emissions of contaminants.

The staff should include personnel capable of reading plans of factories, of combustion equipment, of dust, chemical and fume collectors, etc. They should be able to assist business and industry by locating and pointing out faulty design, and by making constructive suggestions for the correction of faults. They should be qualified to examine and conduct operating tests on any equipment in order to ascertain that it is performing properly and within the required limits. These tests should include combustion efficiency, collector efficiency and stack emission tests.

Engineering should also include laboratory research, testing, and experiments on combustion equipment and collectors, in order to rate and approve or reject supplier's equipment, and to determine the design parameters which should be written into regulations and codes.

- (c) CHEMICAL staff members are necessary to collect and analyse airborne matter. Sampling of air pollutants should not only include dust fall, but also advanced work on the collection and analysis of any and all particulates, gases, vapours, aerosols and fumes which may cause or contribute to air pollution nuisances. The chemical analysis of smog is complicated and requires special apparatus which, at present, is set up in a very few places in the world. Such apparatus should be made available for the Commission. The chemists should also be qualified to analyse fuels of all types.
- (d) MEDICAL personnel with an understanding of the health hazards of air pollution should be engaged. Studies should be designed and conducted to determine more exactly the chronic effects on the human body of air pollution levels usually encountered in our cities.

Types of air contaminants capable of producing acute effects should be recognized where they exist, and plans should be made for the medical care of persons affected, if and when this is found to be necessary.

The medical staff should direct research and statistical studies into ways and means of assisting persons who are suffering from the chronic effects of air pollution. Such problems as the effects on health of airborne pollens, micro-organisms, and spores, and the interaction of these with other organic and inorganic air contaminants should be studied.

- (e) METEOROLOGICAL advice is very important for the proper consideration of almost all air pollution problems. To what extent air contaminants may concentrate in any given district, and in what direction they may move when they leave the area of their source are governed by general weather conditions and also by the effects which the local topography (including tall buildings and other alterations made by man to the natural landscape), may have upon the winds and weather. Therefore, the proposed Commission should have a meteorological expert on its staff who is qualified to collect and assess meteorological data relative to individual air pollution problems.

- (f) LEGAL advice will, of course, also be required by the Commission. The changing nature of air pollution and of the necessary standards, the difficulties of determining precisely the source or sources and the degree of contribution of each to a given air pollution nuisance, the establishment of reasonable and enforceable provisions for codes and rules, and the persuasion and, if necessary, the prosecution of unco-operative violators, demand the employment of a full time legal staff by the Commission. The need for a source of legal advice in this field has been emphasized by several Ontario municipalities.
- (g) PRACTICAL INSPECTORS with a working knowledge of various types of combustion equipment, maintenance problems and the human operating factor are essential. These inspectors should co-operate closely with the engineering and chemical staff to bring to them those difficult problems which require special investigation.
- (h) PROFESSIONAL PUBLIC RELATIONS personnel have been found to be an essential part of every effective air pollution control agency we have studied and should not be neglected by the Commission.

The public is suffering loss and damage from air pollution to an extent which few appreciate. Some citizens may suspect, and a few may know, why clothing and household furnishings become soiled too quickly, why materials and paints become corroded and discoloured earlier than they should, why people suffer headaches, hay fever, asthma, chronic bronchitis, rhinitis and sinusitis, and why there is a markedly higher rate of cancer of the respiratory tract facing those who live in Ontario cities as compared to the rate for the country dweller. But most people have to be informed of the major part air pollution plays in all of this, of those responsible for causing air pollution, and of the costs, effort and time necessary to control air pollution.

An inspection staff is necessarily limited in numbers, and the general public should be taught to assist the inspectors by learning something about air pollution and being able to report emissions, violations and air pollution nuisances promptly, accurately and intelligently to the control officials.

The public should be prepared, by co-operation inspiring publicity, to receive and assist health survey investigators to help solve some of the unsolved problems of the effects of air pollution on human health.

People should be informed of what industry is doing to clean up. They should be told of any especially difficult problem which a particular industry may be facing, and just what efforts are being made to solve it. In this way, understanding and tolerance will take the place of unreasoning emotional irritation, which in itself is detrimental to the health and well being of those in whom it exists.

The public should be told of the ways in which each individual contributes to the total air pollution problem, and educated to cut personal contributions to a minimum, if not eliminate them entirely.

All of this requires a well qualified, diplomatic, public relations staff, able to meet the press and the public, capable of writing informative and interesting articles and advertisements which will be read, and of giving addresses in person, on the radio and over television.

12. THAT THE PROPOSED AIR POLLUTION CONTROL COMMISSION SHOULD GIVE SOME CONSIDERATION TO PLANNING AND ZONING IN ONTARIO MUNICIPALITIES.

As long as industry emits any air contaminants into the atmosphere, zoning and municipal planning are important and will assist in minimizing the nuisance and health effects of objectionable emissions. Therefore, the proposed Air Pollution Control Commission should be prepared to co-operate with and advise the Ontario Department of Planning and Development and local municipal planning boards concerning the most advantageous ways to plan and zone municipalities so as to negate, as much as possible, the effects of air pollution from industry.

The giving of such advice will require an individual diagnosis and prognostication for each separate municipality and problem raised. It will require consideration of the local topography, of meteorological factors such as prevailing winds, seasonal variations, diurnal variations of turbulence, and the effect on weather caused by valleys, lakes, rivers, etc., the nature and size of surrounding structures, the composition of the possible contaminants as determined by the type of industry and the processes involved, and several other related factors. Frequently it is found that the conclusions reached by calculations based on the accepted basic principles of stack design do not agree with what actually happens in practice. Therefore, wind tunnel investigations of scale model arrangements, such as we have witnessed, may be advisable as they can often save a considerable amount of money.

Zoning will, of course, be an effective answer to the local, "spitting distance" type of air pollution nuisance. However, the other, more buoyant kinds of air pollution can easily be carried by air currents far past the limits of any industrial zone which may be established by a planning authority. Therefore, if possible, it is desirable to have things so planned that any air contaminants which do or might escape, will not be required by the predominant meteorological conditions of the district to pass over urban areas.

In special cases where there is a heavy soot or dust fall which drops out of the air to the ground within a short distance from the source, planning is most important. Where the dust which might be emitted is an unusually poisonous,

heavy contaminant (e.g. arsenic or fluoride), it is certainly wise to locate the factory as far away as possible from the homes and haunts of humans and animals to avoid the possibility of serious misadventure.

However, it is our belief that no contamination should be permitted to escape into the atmosphere in the first place. If and when such a highly desirable degree of control is accomplished, zoning, so far as air pollution is concerned, will lose its importance. But, until that happy day, zoning and municipal planning will be subjects of interest to the proposed Ontario Air Pollution Control Commission, and the advice of such an authority may well be sought with advantage by provincial and municipal departments of planning and development.

(D) CONCLUSION: AIR POLLUTION IS EVERYBODY'S BUSINESS

EVERYBODY, and we mean literally every person in the province, whether living in a large city, on a remote farm, or in the bush or mining country, is involved in and should be concerned with this vast, complex, serious problem of air pollution.

EVERYBODY contributes to the steadily increasing sum total of air pollution which flies through the air with the greatest of ease, even up to the Arctic Circle. You may not inhale the air pollution which you personally produce, but someone else, somewhere else, always does; and you, in your turn, must breathe the aerial garbage discarded into the atmosphere by other people, whether you know it or not, and whether you like it or not. This indeed, is the ideal field in which to apply The Golden Rule.

EVERYBODY suffers from air pollution, whether or not he realizes it. Everybody, every day, sustains substantial financial loss because of the pollution in the air. Everybody, especially the housewife, does considerable extra, unnecessary work caused by air pollution. Everybody struggles with some physical and mental ill effects from air pollution, and this Committee is convinced that the effects are fatal sooner or later for no negligible number of unfortunate people. Would you permit someone to force you to drink the sewage from your neighbours' bathtubs and toilets and do nothing in protest? We are satisfied that inhaling the refuse which is carried on every breeze can do you just as much harm and maybe more.

EVERYBODY, and that means not only all Parties in all levels of government, but also every individual citizen, must be made aware of the immensity and importance of this problem and must be educated to be willing and anxious not only to pay for, but to help in every possible way in combatting and controlling air pollution in our province. Air pollution is everybody's concern because it may be anybody's funeral, perhaps yours.

Appendix "A"

Interim Report

**OF THE SELECT COMMITTEE,
APPOINTED BY THE ONTARIO LEGISLATURE,
TO ENQUIRE INTO CERTAIN MATTERS AND
LEGISLATION REGARDING SMOKE CONTROL
AND AIR POLLUTION**

Mr. Alfred H. Cowling, Chairman,

Mr. W. Elmer Brandon, Q.C.,

Mr. Robert E. Elliott,

Mr. George T. Gordon,

Hon. Philip T. Kelly,

Mr. Robert W. Macaulay, Q.C.,

Mr. Ellis P. Morningstar,

Mr. William Murdoch,

Mr. Thomas D. Thomas,

Dr. Frederick A. Evis, Secretary.

February 29th, 1956.

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To The Honourable
The Legislative Assembly
of the Province of Ontario.

Honourable Members:

This Select Committee was appointed on September 8th, 1955, during the First Session of the Twenty-fifth Legislature, on the motion of the Honourable Leslie M. Frost, Q.C., Prime Minister of Ontario, seconded by the Honourable Mr. Porter, Q.C., with the following terms of reference:

"To examine existing legislation and practice in relation to smoke control and air pollution in Ontario with particular reference to the installation and maintenance of equipment to control smoke and air pollution and methods and ways of extending public information in connection therewith."

Since our appointment we have diligently pursued our studies of this matter, but there has not been sufficient time to either finish an adequate general survey of the problem, or to inspect the particular conditions which exist in several Ontario municipalities where inspections are desired. We have nevertheless gained a vast amount of knowledge about air pollution and all of us realize that it is by no means a trivial and unimportant problem. On the contrary, it is one which affects directly or indirectly every citizen in Ontario and it is one which must be faced squarely, handled competently and fearlessly, and eradicated as completely as possible as soon as possible.

Each individual, depending upon his size and amount of activity, uses from 8,000 to 16,000 quarts of air per day. He will drink about four pounds of fluids daily, and eat from two to four pounds of food. However, during the same twenty-four hour period, the 8,000 to 16,000 quarts of air he inhales will amount to from 25 to 50 pounds of air. Most people give considerable thought to the purity of the six to eight pounds of food and drink they consume, but there is usually little concern about the quality of the four to eight times as much air which they take into their bodies. We have put long years of effort into obtaining adequate pure food laws and are continually spending large amounts of money to make sure that these laws are rigorously enforced. It has cost us

millions to make certain that we have pure water to drink in our municipalities. Yet for generations we have been content to inhale several thousand gallons of contaminated air every day. The importance of having clean pure air to breathe cannot be overemphasized. Smoke and smog are wasteful extravagances that no one can afford. It is more expensive to put up with polluted air than to pay the price of having air worth inhaling.

In referring to our subject in the report which follows, we will use the term "air pollution" almost exclusively. This is for two reasons:—Firstly, this term necessarily includes "smoke" as being one type of air pollution; secondly, because the techniques for controlling smoke emissions have been pretty well mastered for us elsewhere in the world.

Hence, smoke should be no great problem in Ontario. It can be eliminated if we will take the trouble and spend the money to eliminate it. When any part of our Province is blanketed with smoke particles it is not because of any lack in technical control knowledge. The trouble lies with our laws and by-laws and the efficiency with which they are enforced, combined with a lack of public spirited co-operation and a disregard for the welfare of the members of the surrounding community on the part of the offender.

What we are really worried about is not so much ordinary smoke, but the hundreds of other kinds of air pollution, many of which are invisible. The problem of air pollution control is completely different from what it was ten, or even five, years ago. In the last five years the petrochemical industry has developed in amazing ways, the chemical manufacturing industry has been growing at a faster rate than all the rest of our industries, and the number of automobiles on our roads has increased by more than 52 per cent.

There is absolutely no reason to believe that our sources of air pollution will decrease in number, or diminish in their output in the future, without control. There is every reason to think that they will increase in number and in kind, and will grow in concentration. Uncontrolled, the quality of our air is certain to become steadily worse.

Air, like water, is a limited natural resource. It has taken us a long time to realize that there is a limit to the amount of man's garbage air can absorb and still be suitable for living in. Many catastrophic incidents throughout the world have demonstrated that there is also a limit to the amount the air can absorb and still sustain life.

We have come to the conclusion that air pollution is a serious, dangerous and costly curse of civilized living. It presents a problem which is gigantic, complex and constantly growing with the increasing population, urbanization, industrialization and prosperity of our Province. The effort and co-operation which will be required from all levels of Government and from each citizen

to assure us of clean air to breathe is the price which we must pay for the conveniences of our modern way of life. If this effort is not made it is inevitable that much of the benefit of our urbanized living will be negated by discomfort, disgruntled dispositions, disease and premature death.

Air pollution can and does have a detrimental effect on the physical and mental health, the efficiency and the well-being of people who must exist in it. There is considerable evidence to indicate that it is one of the principal causes for the growing incidence of lung cancer. It certainly predisposes the individual to other respiratory illnesses and to cardiac trouble, and makes his recovery protracted, or his complaint chronic. It can cause sudden death and has produced many episodes throughout the world which have resulted in large numbers of fatalities.

Air pollution may be an obvious nuisance, or in some cases it may be almost imperceptible to the senses of the average individual living in it until the concentration of the pollutants finally reaches the threshold stage of becoming offensive and irritating. Then everyone exposed will demand immediate relief which cannot possibly be provided in a reasonable length of time. To be satisfactory, action to prevent air pollution must be taken long before the situation becomes severe enough for the general public to realize how much they are being affected. In this case, incidentally, prevention is far cheaper than the cure.

Air pollution always obliterates an appreciable percentage of the sun's beneficial rays. It can easily impair visibility and may do so to the extent that it becomes a danger to, and cause of accidents in, air and ground travel. Depending on the severity, air pollution also removes some or most of the sterilizing action, and other benefits of the sun's radiation, and can in this way contribute to the spread of disease germs. Measurements traced by identical illuminometers, one at Malton and another on the roof of an 18 story building on University Avenue in Toronto, on a recent day, show that, on that occasion, Toronto smog cut down the intensity of sunlight in the city as compared to that at Malton by more than 50 per cent. There were no clouds in the sky when these measurements were taken. Elsewhere the percentage of smog sun loss has been 75 per cent and greater.

The soiling and corrosion effects of air pollution produce great damage to buildings, equipment and machinery, fences, furnishings, furniture and clothing; shortening the useful life of these things and impairing their beauty.

Air pollution can result in damage to vegetation varying from complete death to so-called "imperceptible" damage, which means the crops and plants are smaller and of inferior quality, but otherwise appear normal. Because

air pollution can be carried by air currents for many miles, farms at great distances from the sources of pollution can be affected.

Air pollution is frequently evidence of wasted fuel or of the loss of valuable elements. It can have other very substantial economic consequences to every industry and individual in Ontario. Therefore, equipment for the control of air pollution emissions frequently will pay for itself in a short number of years and sometimes does produce a profit.

Air pollution is also an evidence of bad manners. It is not proper to dump your garbage on your neighbour's land. Neither is it lawful. We have heard it said that smoking chimneys are necessary for prosperity, but we have seen that industry does not have to be bad-mannered to be profitable. In fact, bad-mannered industry drives good-mannered industries out of an area. For example, you cannot operate a precision machine factory next door to an uncontrolled battery of coke ovens. Bad-mannered industry usually employs a relatively small number of people for the area it occupies. Good-mannered industry employs a large number of people for the area it occupies. We are convinced that every industry can clean itself up with the proper guidance. We believe that no industry wishes to be labelled a "bad-mannered industry." Most people want to be good neighbours. Good neighbours are the best neighbours and bring the most profit to the municipality.

The authorities and the people of Great Britain have been struggling with the control of air pollution in that country for over 700 years. In the United States of America millions of dollars are being spent annually by Federal, State and Municipal authorities, as well as by private industry, to provide solutions to air pollution difficulties. It would be a conservative estimate to say that in the next five years our friends to the South will spend more than fifty million dollars on air pollution research alone, without even considering the immense cost of control equipment which will be purchased and installed. The fact that the United States Federal Government has made available for research in this field the sum of five million dollars per year, for each of the next five years, indicates the tremendous importance which is attached to the problem of air pollution by all the best experts across the border.

Your Committee wishes to be able to give Ontario the benefit of as much of the valuable and expensive experience of others as it can acquire. Because the problem is so vast, so difficult and so involved, and the implications are so many and so important, it would have been absolutely impossible for anyone to complete a satisfactory study in this field during the few months in which our Committee has been in existence. To investigate fully all the facets of this vital issue must necessarily require more time than we have had. We desire to make further investigations and to give the matter full and mature consideration before making final positive recommendations to this House.

To that end, we think it desirable to submit an interim report on this occasion and to request the continuance of this Committee.

We have the honour to do so herewith.

SIGNED:

ALFRED H. COWLING, Chairman

W. ELMER BRANDON, Q.C.

ROBERT E. ELLIOTT

GEORGE T. GORDON

HON. PHILIP T. KELLY

ROBERT W. MACAULAY, Q.C.

ELLIS P. MORNINGSTAR

WILLIAM MURDOCH

THOMAS D. THOMAS

The Committee having unanimously agreed upon this Report, Mr. Speaker,
I move its adoption.

ALFRED H. COWLING, Chairman

Interim Report of The Select Committee of The Ontario Legislative Assembly on Air Pollution and Smoke Control

1. INTRODUCTION

Members of this Committee, as representatives of the general public of Ontario, were appointed without any previous specialized knowledge or training in air pollution and smoke control matters. Therefore the following report is condensed from and represents statistical, technical and other types of evidence which has been accumulated by us from specialists and experts who are recognized with high repute in this field.

Also, of course, we have received the benefit of representations which have been made by private individuals and various groups of citizens of our Province, and we have recorded for further consideration the practical problems which atmospheric pollutants have caused them to suffer.

We wish to thank sincerely all those who have co-operated with us in our investigations and who have given so generously of their time, their facilities and their knowledge and experience for our benefit. Our sources of information have received individual credit in our Proceedings and, therefore, we will not take the space to list their names again here.

Certain aspects of this subject appear to be controversial. There are some on which we have not been able, as yet, to acquire sufficient information and experience. Reference to several of these things has been omitted from this report because we do not feel qualified to comment upon them at this stage of our investigations.

One conclusion, however, is undeniable. The expression "free as the air you breathe" is as antiquated as the coal oil lamp. Air costs each one of us a substantial amount of money one way or another. It is much more expensive to put up with polluted air than to pay the price of having air that is worth inhaling.

2. METHOD OF ATTACK

It appeared to this Committee from the start that the most effective, logical and economical attack on the problems presented to us should begin with the discovering, recording and assessing the tremendous volume of facts which are at present known concerning Air Pollution and Smoke Control.

Air Pollution problems have arisen and been tackled in an assortment of ways in many countries, for example: Great Britain, United States of America,

Australia, Japan, Italy, Holland, South Africa, India and Germany. Your Committee wishes to benefit from the experience acquired by others elsewhere, and to avoid the pitfalls into which some of them have stumbled in their struggles to obtain clean air. We have already gathered many scientific and statistical reports and a large amount of other information which demands much more time for reading and careful evaluation.

There is still a great fund of technical knowledge and practical observation easily available to us which we have not had the time to accumulate, but which certainly should be acquired. Therefore, it is vitally important that we be permitted to continue our observations for a further reasonable period so that we will learn sufficient truth about the matter for our final recommendations to be useful and sound.

3. SUMMARY OF COMMITTEE'S ACTIVITIES WITH COMMENTS

This Committee has visited and studied conditions in six metropolitan areas in Ontario and four in the United States of America. Discussions were held with various professional staff members of two state departments, eight municipal departments and fourteen research centres. Fifty-one industrial inspections were made through factories and plants. A total of forty-four reports, petitions and briefs were received. Two hundred and twenty-six individuals made personal appearances before us. Many people and several Ontario municipalities still desire to present their evidence to the Committee.

Following is a partial list of some of the principal sources of pollution which have been studied by the Committee, together with the control methods being used where such existed:

Automotive exhausts, (gasoline and diesel); Automobile Manufacturing; Carbon Black Manufacturing; Cement Manufacturing; Chemical Manufacturing; Cupola (foundry); Furnaces, (coal and electric); Incinerators, (industrial and domestic); Metal Reclaiming; Paint and Varnish Manufacturing; Petroleum Refining; Plastic Manufacturing; Power Plants, (light and heat); Pyrites Roasters; Railroad Locomotives; Rubber Tire Manufacturing; Shipping; Smelting; Soap Manufacturing; Synthetic Rubber Plant; Iron and Steel Production.

Of the foregoing, coal-burning railroads, shipping and pyrites roasters have been visited in Ontario, but these operations especially require further study in the United States where, according to reliable authorities, their emissions are being regularly and consistently satisfactorily controlled.

Some of the other important sources of pollution yet to be observed and requiring further investigation are:—

- (a) ASPHALT MANUFACTURING—There are said to be adequately controlled plants in the eastern United States.

- (b) **BRICK MANUFACTURING AND BURNING**—Apparently this Ontario problem was solved in England many years ago.
- (c) **COKE MANUFACTURING**—Controlled equipment is to be seen in Cleveland, Pittsburgh, and other cities.
- (d) **INCINERATORS**—Municipal incinerators of modern type should be visited.

Apartment incinerators are in extensive use in New York City and cause a vexatious problem wherever they exist. New York is, however, pioneering in this type of incineration and might obtain improved performance as the result of the extensive testing and experimentation now being carried on.

We are aware that inadequate and improperly operated incinerators are in use in the Toronto area at present, and if many more are permitted in Ontario, the problem will become serious and costly. It is estimated that more than 25% of the severe Los Angeles problem is caused by home incineration methods.

A few cities in the United States have been persuaded by incinerator manufacturers that it will "save the municipality money" to dispense with municipal garbage collection and to make the home owners dispose of their garbage by individual incinerators. This, we are convinced, is false economy. The saving of relatively small amounts of tax money by avoiding municipal garbage collection and making individuals burn their own waste is not only a nuisance, it is costly folly. Other cities have discovered to their sorrow that the expense of individual incinerators, plus the cost of the damage they cause, is far greater than any so-called "saving" they make by doing away with municipal garbage pick-up.

Domestic incinerators in many parts of the United States are indeed a very major problem. As a result, manufacturers, having been forced to abandon many American sales outlets, are now attempting to sell their products in Ontario. The choice of prohibition as against control will become much more difficult if domestic incinerators are introduced here in any great numbers. At present, we are most fortunate in not being plagued by the backyard burner with its evils of amateur operation and incomplete combustion. Prompt investigation and decision are necessary to avoid here this type of nuisance which is causing such distress, expense and disease in many American cities.

- (e) **POWER, LIGHT and HEAT**—Power generating stations which are coal fired have been visited, but none where the problem of sulphur emissions has been prominent. Acute sulphur effects and corrosive action have been suspected in Toronto, making sulphur investigations here important.

In New York City, sulphur emissions have caused much property and clothing damage, and corrective action has been ordered there.

In England, it has been estimated that \$750,000,000.00 will have to be spent to control only one-third of their present sulphur emissions.

The cost of installing this corrective equipment is four or five times as great after a power plant is built and operating than it is for a new plant installation. For this reason, and since the need for power in Ontario is steadily increasing, investigation into the resultant pollution control requirements here is essential.

The securing of basic scientific information regarding each air pollution problem, before attempting its solution, is most important. We were told of two cases in one city, for example, in which the proper scientific data saved money to an amount exceeding \$140,000.00.

The sampling, measurement, analysis and detection of air pollutants are procedures about which the Committee still has much to learn. We have observed the use and operation of various types of dustfall collectors, of sulphur dioxide recorders, high volume samplers, smudge and staining filter samplers, ozone samplers, the Ringelmann Chart, infra-red spectrometers, to mention a few pieces of equipment studied. However, we should also give attention to radioactive analysers, directional collectors, visibility and haze measurement, stack sampling equipment, electrostatic and thermal precipitator samplers, impingers, odor samplers, scientific stack emission viewers, and many other kinds of equipment not yet seen.

The matter of proper standards of measurement of pollutants also must receive our attention. Most ordinances and by-laws enacted for the control of emissions of pollutants from stacks, and other sources, have standards indicating the maximum permissible concentrations of pollutants in the source gas stream. The Alkali Works Act of England, when it was enacted in 1863, adopted this method long before any similar action on this continent. This procedure has withstood the tests of nearly a hundred years, but something more might be necessary.

As opposed to emission limits of pollutants measured right at the source, the use of general atmospheric limits is, so far, unusual. However, the latter standard of control has been recently established in one very progressive United States jurisdiction, and in ten years or so it might be required in Ontario. Work by the United States Public Health Service and other research organizations is under way to ascertain the atmospheric limits which should be permitted. Such results as have been obtained so far in this research, and from other active air pollution research which is expected to show definite progress or reach final conclusions in 1956, should be obtained for our deliberations.

In general, the Committee is already satisfied that advances in science have now made it technically possible to eliminate, or satisfactorily to control, almost every kind of air pollution.

Authorities we have consulted are unanimous in stating that it is not only economically feasible, but necessary, to put adequate controls on all sources of air pollution.

There are, however, a few types of pollution which require more scientific study, and many methods of detecting and controlling or eliminating them require further investigation and development. One of these is the exhaust of internal combustion engines.

The major automobile manufacturing companies are at present pooling their facilities and scientific brains in a vigorous attack on the problem of automobile exhausts. These companies are currently spending their money on this research at the rate of more than one million dollars per year. One of their top officials, speaking for all of the companies, told us that they confidently expect to have a practical answer to this question early in the year 1957.

When practical equipment is invented to control the pollutants in automobile exhausts, it would be highly desirable to make such equipment mandatory on every car in Ontario.

4. AIR POLLUTION IN SIMPLE TERMS

Air pollution is the result of the excessive use of the atmosphere by man for waste disposal, combined with certain predisposing and contributing factors provided by nature. Man's part comprises emission into the air of smoke, soot, fly ash, cinders, dusts, gases, vapours, fumes and odours. Nature's contribution might be a topography which hinders winds in their efforts to disperse man's airborne garbage, it might be humidity and fog, it might be too much wind or no wind at all, it might be just plain sunlight which catalyzes reactions in the air between various of man's contaminants, it might be a "temperature inversion," or it might be other conditions or combinations of conditions.

A word of explanation should be said about the term "temperature inversion." This is a meteorological condition composed of a layer of warm air, maybe one or perhaps two thousand feet in thickness, which rides like a lid on top of five hundred or a thousand feet of cooler ground level atmosphere. This phenomenon effectively prevents man's pollutants from rising above the bottom of this "inversion layer." As a consequence, they continue to concentrate, to inter-react and to annoy. If the process continues for a short while, the "saturation point" of contamination is reached and mucous membrane irritation and other ill effects become immediately apparent to humans and animals. If the condition persists long enough, death is the consequence for many. "Long enough" has meant, in several instances, only four, five, or six days.

There exists a close relationship between topography and weather conditions, and the concentration of air contamination present in an area during any given period of time.

The normal condition of the atmosphere is for the air nearest the ground to be the warmest, and for the temperature of the air to drop, gradually, the higher it is measured above the ground level. In this normal situation pollutants are dispersed horizontally by winds, and upwards by vertical convection currents, or by the usual upward movement of parcels of warmed air which rise naturally, as with smoke and heated gases from a chimney.

However, if the winds are very light, or if there is no wind, horizontal dispersion may stop completely. Mountains, hills, tall buildings and other obstructions will also block horizontal wind assistance to dispersion to a greater or lesser degree depending upon their size.

In addition, vertical dissemination of pollutants may also be checked by the "temperature inversion blanket" over the ground layer of cooler air, preventing the usual upward movement.

The two conditions of no horizontal displacement and blocked vertical escape often develop together at the same time as the surface air cools down during the night. This situation occurs most frequently during the late Summer, the Fall and the Winter months, with the resultant accumulation of smog cutting off much of the direct sunlight and preventing the ground and the ground layer from heating up as they should, and thus creating a "vicious circle." The contaminants which continue to be exhaled by man, his processes and his devices, continue to accumulate beneath the inversion "blanket" or "lid" until finally, strong, favourable winds do arrive to disperse the smog and bring welcome relief.

Following is a summary, simplified classification of air pollutants and what they can do.

(A) WHAT AIR POLLUTANTS LOOK LIKE:

- (i) **LARGE PARTICLES**—By "large" we mean the size of the "cinder" which gets in your eye, and which you can see and remove. These fall to earth relatively quickly and form a major part of the "dustfall" which is collected in many cities and reported as so many "tons per square mile, per month" or "per year."
- (ii) **SMALL PARTICLES**—These are so minute that they remain in suspension for long periods of time and can travel with air currents for many miles. They form a part of the haze which hangs like a pall over our cities. They penetrate into the depth of our lungs. Pollen, "radio-active fall out" and fumes produced by the volatilization of elements are three special classes in this group.

- (iii) **LIQUID DROPS**—These may be very small drops, (for example, produced by the bubbling of an acid or some other chemical from an industrial process), which can be carried in the air for relatively short distances and create a “spitting distance” nuisance, or they may remain suspended as a “mist” for a period of time.
- (iv) **MICROSCOPIC DROPLETS**—These are the size of the extremely small droplets in cigarette smoke and smaller. They may be droplets of oils, or other liquids, so small that one of them alone cannot be seen by the naked eye. However, many of them together will produce a blue cloud—a definite smog haze. They can be carried for very great distances in the air.
- (v) **VAPOURS and GASES**—These may be merely an odour nuisance factor. However, they may be either annoying or damaging in themselves, or may react in the atmosphere to produce other irritating or dangerous compounds.

(B) WHAT AIR POLLUTANTS DO:

- (i) **SOILING EFFECT**—(a) **Dirty Black or Brown:** This type of soiling shows up on laundry, clothing, drapes, furniture, inside walls, the outside of buildings, windows, etc.
 (b) **Creamy or White:** This is the dust you have to wipe off your furniture and automobile.
- (ii) **PROPERTY DAMAGE**—Both of the soiling effects can cause definite property damage by abrasion and in other ways. In addition to the surface dirt, which may be difficult to remove and be a cause of damage in the removing process, there are chemical effects which result in—
 (a) **Paint discolouration and damage.**
 (b) **Corrosion of metal, wood, stone, cement, rubber and fabrics.**
 Aside from specific damage, property values are invariably lower in dirty, smelly areas.
- (iii) **VEGETATION DAMAGE**—This may be “obvious” and even amount to complete death of the crop or plants. It may be “imperceptible” or “hidden”, in which case the plant and the fruit appear normal at first glance, but are actually smaller and of inferior quality than the normal. There are special circumstances in which cattle and other livestock may be killed or injured by eating vegetation which has accumulated some specific air pollutant in its fibres and/or on its surfaces.

- (iv) **NUISANCE**—This may be an offensive odour, or an irritation to the eyes, nose, throat, bronchial tubes, skin, etc.

Nuisances are usually created by specific offenders who cause annoyance and interfere with the rights of their neighbours to enjoy their homes and property. Many nuisances exist in Ontario. The word "nuisance" cannot be exactly defined at present for legislative purposes, and a review of legal cases is necessary to ascertain the rights of the public and the duty of the province to protect the public when the nuisance originates from such sources as railroads and steamships.

The control of odours by the masking of them with some chemical is being promoted by certain organizations, but the desirability of this solution is widely debated and some authorities forbid this form of "control."

- (v) **SKY DARKENING**—Pollutants can cut out much of the sun's light and other beneficial radiation. This may contribute to the spread of infectious diseases and can increase the severity of mental depression.

Dust, alone, will scatter, reflect and absorb much of the sun's radiation so that it cannot reach the earth's surface. Reduction of sunlight intensity solely because of air pollution has been as high as 75% in some cities, and occasionally even higher. This appreciably shortens the length of the day, causing increased expense by making it necessary to use extra electric light for longer periods of time.

- (vi) **VIEW IMPAIRING**—This not only causes loss of landscape beauty and of the aesthetic appeal of man's buildings, but can be a definite hazard and the cause of accidents in ground, sea and air travel. This also contributes to mental depression and irritability.

- (vii) **HEALTH DAMAGE**—This may be physical and/or mental detriment. Depending on the nature of the air pollutants present, their concentrations, inter-reactions and duration, this health damage can range in degree from mental depression and loss of normal mental and physical efficiency, through "chronic bronchitis" and allergic manifestations, to lung cancer and death.

As far back as 1932 and 1933, the United States Public Health Service made a survey of American cities with regard to disease as related to air pollution. One of the obvious conclusions from that study was that the four most polluted cities in those years ranked in the same order as their degree of air pollution in the matter of the number of pneumonia deaths per year. Pittsburgh was found to have the most severe air pollution and it also had the greatest number of pneumonia deaths in the United States per 100,000 population. Pittsburgh was followed by Boston, Baltimore and St. Louis, which ranked in that order

in parallel, positive correlation between diminishing amounts of air pollution and decreasing incidence of pneumonia deaths.

"British bronchitis" and the high incidence of other respiratory diseases in Great Britain have been well known for years. The British consider air pollution to be responsible for these persistent chest ailments. This belief was substantiated by recent events in Liverpool and other overseas cities.

Early in 1956, J. A. Scott, O.B.E., M.D., M.R.C.P., F.R.S.H., the Medical Officer of Health for the London County Council, in commenting on Sir Hugh Beaver's "Clean Air Bill," was quoted in the *Journal of the Royal Society for the Promotion of Health*, (Vol. 76, No. 1, January, 1956), as saying:

"The four-day fog of December, 1952 caused at least 4,000 deaths in the Greater London Area. It is not too fanciful to compare it medically to an acute exacerbation of a chronic illness, or to an epidemic flare-up of an endemic disease. Certain it is that atmospheric pollution in this country exacts a regular toll of ill-health and death quite apart from its considerable economic effects."

It has been noted by many investigators that the maximum allowable concentration of sulphur dioxide permitted in air inside industrial plants for an eight-hour working day has been set at 10 parts per million. However, they point out, the densest concentrations recorded for sulphur dioxide in the atmosphere over London, England, and other cities where large numbers of deaths resulted from lethally severe smog episodes, have been recorded at about 2 p.p.m. or less. The possible conclusions are either that the M.A.C., which has been established by industrial hygienists for industrial exposure is much too high, or when sulphur dioxide is emitted into an atmosphere already contaminated with a complex mixture of other pollutants, something takes place which makes the deleterious effects of oxides of sulphur on health much more pronounced.

Dr. J. A. Scott, in commenting on the investigation of the London smog deaths said that "a concentration of sulphur dioxide and sulphur trioxide which is less than toxic can be rapidly fatal when inhaled by animals and humans as an aerosol."

Other investigators have suggested that the explanation may also be, in part, that oxides of sulphur are concentrated by adsorption on minute particles of solid air contaminants which are small enough to be inhaled deep into the lungs. In this way, they believe, the lung tissues are exposed to concentrations of oxides of sulphur which are much greater than those actually measured in analysed samples of the atmosphere.

Various statistical studies made in England, Wales, the United States of America and Denmark show that the mortality from lung cancer is much higher in urban areas than in rural.

In Ontario, vital statistics indicate that male death rates from malignant neoplasms of the trachea, bronchus and lung are unexpectedly high in Toronto and Windsor; from cancer of all forms in Hamilton, Ottawa, Toronto and Windsor; from pneumonia and bronchitis in Toronto; and from respiratory tuberculosis in Ottawa. (The data from other large Ontario cities were not analysed in this survey.)

On the other hand, death rates from cancer of the trachea, lung and bronchus, from cancer of all kinds, and from pneumonia and bronchitis are unexpectedly low in the rural Ontario areas and in Ontario municipalities with populations less than 15,000.

The reasons for these differences between incidence of disease in urban as compared with rural areas cannot be definitely stated from the evidence now available, because there are many variables which may be involved as causes of respiratory disease in addition to the amount of air pollution encountered. However, it is reasonable to assume that at least a large part of the reason for the greater incidence of cancer, and other diseases of the respiratory system, in the large centres is the greater concentration of air pollutants to be found in those places.

Because carcinogenic substances can be isolated from the smog atmosphere which is breathed by those in large cities, and for other reasons, several responsible medical authorities have unequivocally named air pollution as a major cause of respiratory cancer. Every year more authorities are expressing the opinion that severe injury to health is being produced by air pollution.

As we have indicated, although scientific evidence about the effects of air pollution on human health is far from complete, enough proof exists to make it abundantly and increasingly clear that air pollution is injurious to both physical and mental health. Under certain combinations of circumstances it can be fatal. It fosters disease, and it is very probably a major cause of lung cancer, if not of other forms of malignancy.

Although intermittent lethal episodes have terrified people in the vicinity and aroused their indignation, it is becoming progressively more apparent to the Committee that more important is the continuing daily damage being done to the efficiency and the health of urban dwellers. Therefore, it is important that effective control measures be taken even by those municipalities where the local air pollution problem is still in its early phases.

As Ontario urban centres increase in size, in population, and in automobile registration, severe difficulties produced by the resultant air pollution are inevitable unless corrective measures are instituted early.

In order to have air pollution control measures undertaken before an acute situation develops, considerable public understanding and support are required.

5. PUBLIC SUPPORT REQUIRED

It appears to us, at this stage of our work, that there are many preventive measures which should be practical for adoption on short notice, while others must involve special scientific study together with protracted public education and guidance, in order to achieve the ultimate goal of pure air in spite of modern living conditions.

Experience elsewhere in the last five years has demonstrated the value of, and the need for, proper public understanding in this field. It is clear that if the people are not informed in advance, when an air pollution situation becomes acute and they clamour for laws which will provide immediate relief, they are likely to get faulty and expensive laws as the result.

One large centre neglected public education for several years and, although the air pollution control officials were doing technically good and useful work, the public did not realize the extent of the problem, nor the Herculean task of correcting it. Considerable trouble developed from this lack of understanding.

As a result, it was found necessary to have the municipal air pollution control department staff include a Public Services Officer in charge of a General Information Division of seven experts in education and public relations. Various informative publications are available, and pamphlets and bulletins are frequently issued. These are distributed to a mailing list and also may be ordered from this division by telephone or mail.

Forty-two university trained experts on the staff of the Air Pollution Control Department have been organized to form a Speakers' Bureau. The speakers are specialists in all the various aspects of air pollution control, enforcement, engineering, research, meteorology, education, etc. They will provide lectures on any or all phases of the problem and its control. Their talks are amply illustrated by excellent motion pictures, slides, photographs, graphs, displays and other illustrative material.

On request, the Speakers' Bureau will provide a program suitable to the needs of the group requesting it. The length of this program may be anything from a half-hour after-dinner talk to a full two-day detailed course of instruction. To illustrate the demand for this service, during the one month of September, 1955, one member of the General Information Division delivered 129 speeches to service clubs, school teachers, church associations and other civic groups in the area. These talks are not only informative, but are also entertaining and designed to stimulate intelligent public interest, thought and action.

As the situation exists at present in Ontario, it is unlikely that we will require such a large public relations staff. However, the matter of public education and the best way to achieve it must receive serious consideration and must not be neglected.

In Great Britain also, Sir Hugh Beaver (the Chairman of the British Government Committee on Air Pollution), realizes the value of strong public support for air pollution control. He recently blamed lack of public knowledge for the 700 years of ineffectual attack on the progressive air pollution conditions which culminated in the four-day smog of December, 1952, causing "at least 4,000 deaths in the London area" and the resultant appointment of Sir Hugh's Committee. Sir Hugh Beaver, in speaking about smoke, said "both criticism and attack have been violent enough, and I think one may well feel surprised how, generation after generation, the evil has been described in such scathing terms and the practicability of effective action so repeatedly demonstrated—and yet nothing, or almost nothing, has been accomplished."

Sir Hugh has commented on the many committees which have been appointed through the years by the British Government. He quoted from the concluding paragraph of the report made by the committee which preceded his by 33 years: "No Government has for many years taken any action with the exception of appointing committees whose labours have led to little or no result."

Sir Hugh pointed out that 700 years ago the then Queen of England moved out of the city of Nottingham where she was residing "because of the insufferable smoke"; and that some 300 years later the brewers of Westminster offered to burn wood instead of coal because of the allergy of Queen Elizabeth I to coal smoke. But it was only about the end of her reign that feeling began to lead to action; and then there was a prohibition—"probably ineffective"—of the use of coal in London "while Parliament was sitting!"

Sir Hugh states "experience has shown that on public opinion, and on it alone, finally rests the issue." He goes farther to say: "Good legislation itself will be ineffective unless public opinion supports its enforcement."

A recent survey of leading industrial corporations in the U.S.A. found that top management in that country classifies air pollution as "a major public relations problem." They say that there is "an increasing and more aggressive public awareness of air pollution as a nation-wide issue." They advise all industry to tell its neighbours in the communities where plants are located, just what they have done and are doing to control air pollution, and how much it is costing. "Industrial air pollution is frequently as much a public relations as an engineering problem."

Industries who have kept their neighbours informed in this way have told us that the dividends returned in public appreciation, gratitude, good will and general public relations, could probably never have been bought with the money spent for the control equipment purchased.

This Committee believes that the public should be made aware and kept well informed about the causes, effects and methods of prevention of smoke

and other types of air pollution. Understanding of this subject will create a strong supporting public interest.

This general support is needed because air pollution control is apparently often an expensive process. Wherever this money comes from, in the last analysis it has to be paid, one way or another, by the individual citizen. Hence, he should be informed that, while it is a costly business, it is one which we cannot afford to neglect any longer. He should know that such spending is more than highly desirable, it is absolutely necessary. He should realize the tremendous cost in dollars and in loss of health and comfort, which we are all paying today for damage done by air pollutants. Elsewhere, other people have already had to learn this "the hard way". He must be convinced that air pollution control will pay worth-while and substantial dividends to him and his family in health, comfort and cash saved.

When people know they are getting good value for their money, they do not object to the expenditure. In Detroit, for example, \$18,000,000 has been spent on air pollution control equipment alone in the past seven years. Several officials of that city stated that they have never heard "even a suggestion" that one penny of the money was being wasted, or spent for an unnecessary purpose.

"Mr. Average Citizen" should also know about air pollution because he is one of the causes of it. From our studies, it is obvious to us that industry is not alone to blame for polluted air and that it behooves every individual to be his own constant smoke inspector. For example, he should not burn leaves, trash, or other open fires in his yard; he should not buy a home incinerator; he should learn how to properly and economically heat his own house, and he should keep his automobile, truck or motorcycle in good repair and adjustment, so that it runs as efficiently as possible and does not emit a smoky exhaust.

The practical experience of others, and many reasons, indicate to us the need for public information and understanding on this subject to be extended and for a strong public interest supporting air pollution control to be aroused. While we are not prepared at this time to recommend by what method or methods this should be accomplished, we must not forget that the enactment of a strong law with no exemptions, and "with teeth in it," will, itself, do much to educate industry and the general public in this vital matter which affects each one of us.

6. THE COST OF AIR POLLUTION

The cost to the citizens of Ontario of existing air pollution can only be given as a considered guess. This is because there is no giant provincial ledger in which is recorded the cost of wasted fuels, of property damage and depreciation, of extra laundry and cleaning bills, of additional electricity used, of

injury to plants, crops, soil and animals, and of other expenses caused by our polluted air. Also, no one can estimate in dollars the cost of air pollution inspired discomfort, loss of efficiency, illness, misery, work loss and premature deaths.

However, careful surveys have been made in Great Britain and in several United States cities which provide at least an estimate of the order of magnitude of the waste caused by air pollution. These survey reports all emphasize the fact that the figures quoted are on the conservative side and are also low because only those costs are considered which can be measured in terms of money. Such items as discomfort, loss of efficiency, loss of health and life, effects on transportation, losses from retarded growth of crops and cattle, illness, the unpaid extra labour of housewives whose work is considerably increased in polluted areas, etc., are not included in the estimates.

In Great Britain the cost per person per year is estimated to vary from \$15.00 for the overall population to at least \$30.00 for those living in "the black areas."

In Chicago, a recent estimate gives the amount of \$20.00 per head of population per year, and in Greater New York the figure has been set at \$16.00 per person.

In the City of Pittsburgh, an estimate of the expense of air pollution, made before action was begun to control it, placed the cost at about \$20.00 per person per year. However, the 1952 Report of the Bureau of Smoke Prevention of Pittsburgh estimates the annual saving within the city limits resulting from the elimination of smoke at a total of \$27,000,000.00 or \$41.00 per person per year.

Since there is some evidence to indicate that Toronto air now has approximately the same degree of pollution that Pittsburgh suffered before the "clean-up" there, it is reasonable to assume that the polluted air in Toronto at present costs each citizen at least \$40.00 annually. It is also probable that the expense per person in other Ontario metropolitan areas runs somewhere between \$25.00 and \$40.00 per year, depending on the amount of the local air pollution.

It would be a very conservative estimate to say that in the next five years our friends in the United States will spend more than fifty million dollars on air pollution research alone. Without giving the large figures for the spending by State Governments and by privately financed corporations for air pollution research, the fact that the United States Federal Government has made available for research in this field the sum of five million dollars per year for each of the next five years indicates the tremendous importance which is attached to this problem by all the best experts across the border.

It would be impossible to say exactly how much money will be spent by industry during the next five years for equipment to control air pollution.

However, the results, published in 1956, of a careful U.S.A. survey of leading industrial executives and of the air pollution control officials for 67 major industrial cities, will give us some indication of the great concern which air pollution problems are causing in that country. They also point the way in which we should follow.

69% of industry surveyed reported expenditures made in the last five years to control air pollution ranging from \$1,700.00 to \$20,000,000.00 per company. Only 5% of the corporations reported no expenditures made for this purpose in the past five years.

35% of the companies said they thought they had already solved their air pollution problem. Another 30% of them felt that they were well on the way to having it solved.

27% of the industries reported plans for expenditures estimated to range from \$50,000.00 to \$15,000,000.00, per company, over the next five years to control their air pollution.

The twenty companies whose plans have progressed so far as to enable them to give detailed dollar estimates reported expenditures to be made over the next five years which will total \$52,730,000.00.

Only a very few industries said there would be no need for them to make further air pollution control expenditures.

74% of the corporations said that major consideration is always given by their executives to air pollution control when their companies plan new construction. Only 8% of the industries said it was not a problem with them.

Experts in the United States have told this Committee that it is not unreasonable for the average industry to spend between 2% and 5% of its capital cost on air pollution control equipment, and that such money is always well spent.

In the very rare instance, where an unusual pollutant is exceptionally difficult to control in an old established factory, companies have invested as much as 10% to 20% of their capital expenditure for control purposes.

It has been repeatedly emphasized to us that these expenses frequently may be from two to five times as great when the correction is applied to an existing operating plant, than they are when control equipment is installed at the time a factory is first erected. We commend this fact to the Legislative Assembly, and to the consideration of industries which are contemplating the construction of new factories, or additions to existing plants.

We have discovered no instance of an industry being prejudiced in its operations by being required to install air pollution control equipment. Because air pollution is almost always a sign of waste, money spent on air pollution

control usually brings a substantial return and sometimes is a profitable investment.

The individual who resides in a rural part of the province should not assume that he is free of the burden of air pollution merely because he lives in the country. In addition to the fact that he has to pay for money wasted in the cities, because the cost of urban air pollution must be reflected in the increased price of the city-made products which he purchases; he must also remember that masses of polluted atmosphere can be and are carried by air currents many, many miles from their sources. They may even be regularly, or on occasion, dumping aerial garbage on his farm.

For example, in the late 1920's Stevens County in a remote section of northwestern Washington State was reported to have become a scene of devastation, with trees and crops dying, orchards barren, the soil no longer able to produce grass for livestock, and farm machinery corroding in its sheds.

The problem was referred to an International Joint Commission which was appointed to investigate the trouble. It found the cause of the destruction to forest and farm lands to be sulphur dioxide emitted into the atmosphere by a smelter in Trail, British Columbia. Hundreds of thousands of dollars had to be paid by the company in settlement of damage claims. The destruction produced by the pollution which the smelter spewed into the air extended for many miles, right across the international border.

This international incident vividly illustrates two facts:

- (a) Even the farmer living remote from a metropolitan area or other source of air pollution should have and take a real interest in air pollution control, and
- (b) neither provincial, state nor national boundaries are barriers to the spread of atmospheric pollution.

7. THE INTERNATIONAL ASPECT OF AIR POLLUTION

There is a large international aspect to this problem which the International Joint Commission has been studying for several years in the Windsor-Detroit region.

The situation in the Sarnia-Port Huron district also reached international proportions and the Ontario Research Foundation has been working there, with the full co-operation of local industries in Sarnia.

Elsewhere along Ontario's border with the United States, air pollution problems from each side are affecting the other.

The International Joint Commission is to bring before the Federal Governments of the United States and Canada, in April, 1956, its findings and recommendations from the Windsor-Detroit work.

The life of this Committee should be continued so that it can attend when the International Joint Commission's recommendations are being made, because it is not possible to legislate intelligently regarding air pollution control unless the international aspects of the problem are fully considered.

As there seems to be some difference of responsible opinion as to where the legislative power lies with regard to some aspects of air pollution control, it would be most desirable for this Committee to receive the benefit of the findings and deliberations of the International Joint Commission before attempting to formulate any provincial legislation for recommendation to this House.

Also, the Committee has been invited to attend the International Meeting of the Air Pollution Control Association which is to be held in the Niagara Falls-Buffalo-Fort Erie district during the last week of May, 1956. This meeting is to give consideration to the solving of the several international difficulties which are caused by air pollution originating from both sides of the Niagara River border.

8. AIR POLLUTION CONTROL EQUIPMENT

With regard to the equipment used to control air pollution, the Committee requires more time for study. We have learned that some well-advertised equipment in this field does not live up to the claims made for it by manufacturers, and some definitely does not give satisfactory results.

It is extremely difficult for the uninitiated individual, industry or municipality to make an intelligent choice of the proper control equipment to solve the problem at hand, because of lack of accurate knowledge, and the ability and methods to verify the manufacturers' claims before the equipment is ordered and installed.

As most air pollution control equipment is quite expensive, mistakes in selecting it can be costly. Hence, it would be desirable if this Committee could make recommendations concerning standards and procedures for the guidance of those who have the task of approving or rejecting, control apparatus. Or, alternatively, if we might better give consideration to the establishment of an organization to provide such assistance on a continuing basis.

This subject of control equipment requires further study and consideration on our part as it has not been possible for us to give it more than a small amount of our attention.

9. AIR POLLUTION CONTROL METHODS

Every piece of legislation and each local by-law and ordinance which has been examined by this Committee has suffered from some serious defect or deficiency so far as Ontario application is concerned.

The failure of existing laws to properly achieve their purpose has been due to many factors. One of the most important of these has been failure to keep the provisions of the legislation abreast with scientific knowledge and technical progress. For example, there are certain industries which are effectively exempted by our Ontario Legislation because municipalities consider the method provided for bringing such industries under the provisions of their air pollution control by-laws much too cumbersome, uncertain, time consuming and costly. The idea of these "exemptions" originated in the 1800's at a time when the types of pollution concerned could not be controlled. They can be controlled today, and some of them have been controlled satisfactorily in other countries for years.

Other common factors which produce partial or substantial failure of air pollution control laws are difficulty or expense of enforcement by the municipality, the municipality not providing suitable or sufficient testing equipment for its enforcement staff, the use of untrained or inadequately trained enforcement personnel, the lack of informed public opinion and, last but not least, inadequate penalties. In one jurisdiction, for example, the fine of \$100.00 for open fires was not sufficient to deter building wreckers from burning scrap lumber and other waste materials on the site of each wrecked building. It cost the wrecking company \$300.00, or more, to dispose of the material by hauling it away. Therefore, its employees were instructed to "always light the fire even if the fine has to be paid," and they "often did not get caught."

One standard model by-law for recommendation to each municipality in the province is not considered by this Committee to be the most satisfactory solution to the problem of enforcement of air pollution control measures.

Each municipality is like a patient whose condition requires a personal examination and diagnosis, and whose health demands an individual treatment to achieve a successful result.

The field of smoke abatement appears to be such that its problems can be dealt with adequately at the local level in most cities, except possibly where a smoke nuisance originating in one municipality affects a neighbouring centre, thus raising a jurisdictional issue.

This is not true, however, with other types of air pollution. Most pollution problems are complex and only the very largest cities can afford to engage properly trained personnel, or to supply the necessary equipment required to

handle the difficulties encountered. For the majority of air pollution problems, the technical difficulties appear to be so serious as to require a substantial measure of provincial participation in a control program.

We have discovered that municipalities with less than about 100,000 population cannot justify the expense necessary to provide the required technical investigation and the proper enforcement of air pollution control measures. Even cities with under 1,000,000 people are limited in their ability to reasonably handle complex air pollution problems. They require outside help.

Several representations from Ontario municipalities and Ontario industry have either suggested or requested that a central Provincial Government agency be established to give scientific assistance, to lend scientific instruments and to give technical advice to them. The Ontario Research Foundation has also recommended a similar provincial policy. In England, air pollution work involving any problem that is at all technical is done by a central agency. It would be desirable to give consideration to the providing of some similar central assistance agency in Ontario for this purpose.

With further investigation, study and consideration, this Committee believes that effective, flexible provincial legislation can be devised for recommendation to the Legislative Assembly which will be applicable to the needs, and within the financial and enforcement capabilities of Ontario municipalities of all sizes, from the smallest town to the largest metropolitan area.

10. AUTOMOBILE REGISTRATION AND AIR POLLUTION

The role of automobile exhaust in smog formation has been emphasized by the Los Angeles situation. Authorities there believe that about 50% of their problem is caused by gasoline powered vehicles.

There is a great amount of information available on the volume and composition of automobile exhaust gases with regard to the "major" components, viz.: carbon dioxide, carbon monoxide, water vapour, hydrogen, nitrogen oxides and oxygen. However, until very recently knowledge has been only fragmentary with regard to the other constituents, which are unburnt, or partially burnt, hydrocarbons, and which are alleged to be the principal contributions of the gasoline engine to smog.

The internal combustion engine is designed to be operated under "rich mixture" conditions, i.e. insufficient air is taken in to permit complete combustion of the fuel. Therefore, part of the fuel passes out the exhaust pipe only partially burned, or completely unburned. There are, of course, other irritating emissions from cars, e.g. from crankcase breather pipes which contain decomposition and oxidation products of lubricating oil. Also, whenever a driver buys gasoline and has it put into his empty tank, an equivalent volume

of concentrated, unburned, gasoline vapour is expelled from the tank into the atmosphere as the gas is poured into it.

Professor Haagen-Smit has done, and is doing, a great amount of work on the problem of automobile exhaust products and their effects. His theory, which appears to fit the facts, says that the auto exhaust hydrocarbons, in the presence of nitrogen dioxide (and maybe other air contaminants), in concentrations of the same order as those experienced in Los Angeles, react, in the presence of sunlight and are converted into oxidation products, which are responsible for the eye-irritating, plant damaging, and reduced-visibility characteristics of smog.

The intermediate reaction products are believed to break down to form ozone, which, in turn, may further oxidize certain of the hydrocarbons in the air, principally the olefins. Some of these intermediate products, (e.g. ozonides and peroxides of hydrocarbons), and the ozone itself, are believed to comprise the "high oxidant" content of the Los Angeles atmosphere which is the cause of the rapid deterioration of rubber and other objectionable effects experienced in that region.

The presence of sunlight is necessary for the reaction to take place between nitrogen dioxide and the hydrocarbons to form ozone and other oxidants. However, once they are formed, the further reactions between the oxidants and hydrocarbons are not influenced by the presence or absence of light and therefore can continue after sundown. That is why the concentration of oxidants in the air is high during the daytime sunlight and then decreases markedly at night as they are used up in the second stage reactions.

While the mountains around the rim of the Los Angeles "basin" tend to prevent dissipation of these pollutants, it must not be assumed that such a topography is required for the pollutants to reach the concentration necessary to produce effects attributed to the hydrocarbon-auto-exhaust type of pollution. As automobile registration steadily increases, more and more cities are experiencing the type of irritation which was first noticed in Los Angeles. Already more than 25 of the 100 largest cities in the United States have reported that eye irritation occurs occasionally, which indicates that the atmosphere over those cities is on the verge of reaching its "saturation point" for these pollutants. In Ontario we received reports of eye-irritating episodes in Sarnia, and it is probable that much of the relatively mild eye-irritation experienced on sunny days in downtown Toronto may be attributed to the same cause.

"Synthetic smog" has been prepared directly from hydrocarbons and also from actual automobile exhausts. Haagen-Smit was the first to do such experiments under the auspices of the Air Pollution Control District of Los Angeles. Now, many scientific investigators of the highest calibre are at work on the problem, financed by the Air Pollution Control District, the Air Pollution Foundation, Federal and State Government Grants, and by private industry.

The Stanford Research Institute has done considerable research on Smog and has reported that "gasoline vapors, mixed with ozone so that visible fuming occurred, caused plant damage in six hours with concentrations as low as 3 parts per million of regular gasoline and 0.4 p.p.m. of ozone. The same degree of damage was produced by exposure for five hours to a mixture of 2 p.p.m. of premium-grade gasoline and 0.4 p.p.m. of ozone." This confirms the earlier experiments along this line which were done by Haagen-Smit.

The number of vehicles registered in Los Angeles County increased from 871,773 in 1930 to 1,229,194 in 1940. However, with that concentration of cars there were no apparent "hydrocarbon-oxidant" air pollution effects. Finally, about 1946 these effects were beginning to be generally noticed by many people. By 1953 the number of vehicles in the County had risen to 2,427,566, which represents 412 motor cars per 1,000 persons. By 1953, the smog effects had become acute, severe and frequent. At the beginning of 1955 the registration had increased to about 460 cars per 1,000 population. The eye-irritation and other hydrocarbon-oxidant effects became more frequent and more severe as a result, in spite of strenuous and expensive efforts which have been made to control other types of air pollution.

In Ontario the concentration of cars was about 280 cars per 1,000 persons in 1954. In Metropolitan Toronto the estimate is about 310 cars per 1,000 population for 1955.

In 1945 there were 158,000 motor vehicles registered in York County. Today it is estimated that there are 440,000 vehicles registered in the Toronto planning area which is bounded by Clarkson, Richmond Hill, Ajax and the shores of Lake Ontario.

Actual traffic count shows that 66,750 vehicles enter and leave the downtown Toronto area in the fifteen hour period from 7 a.m. to 10 p.m. on an average week day. This figure does not include the lakeshore traffic which by-passes the downtown area, nor does it include the cars which are left in the parking lots on the waterfront.

In 1949 the motor vehicle registration for Ontario was 955,307. This figure rose to 1,083,943 in 1950 and to 1,459,966 in 1954. The Provincial figures for 1955 are not available to us at this time. However, in the five year period from 1949 to 1954, the motor vehicle registration in Ontario had increased by 504,659, i.e. by more than 100,000 cars per year. This is an increase of more than 52% in a five year period.

The leading automobile manufacturers are at present pooling their research facilities, their brains and money, to the extent of more than one million dollars per year, to improve the quality of automobile exhaust from an air pollution standpoint. It is probable that a new type of carburetion will be developed

which will give a more perfect combustion of the fuel and also that some type of catalytic exhaust muffler will prove useful to prevent the escape of hydrocarbons into the air.

As soon as effective and practical devices are invented and made available to improve the quality of automobile exhaust, their attachment should be made mandatory on every gasoline powered motor vehicle in Ontario.

11. INTERIM CONCLUSIONS AND IDEAS WORTHY OF FURTHER CONSIDERATION

- (a) Everyone inhales from 8,000 to 16,000 quarts of air per day. This amounts to from 25 to 50 pounds of air used, as compared to only two to four pounds of food and about four pounds of fluids which are consumed daily by the average person. Most people give considerable thought to the purity of their food and drink, but there is little concern usually shown about the quality of the air which they take into their bodies. We wish to point out that the purity of the air we breathe is of paramount importance to each of us.
- (b) Air pollution is the result of the excessive use of the atmosphere by man for waste disposal, combined with certain predisposing and contributing factors provided by nature in the form of topographical and meteorological conditions.
- (c) Air pollution is not only an expensive nuisance, it is a danger. It is an extravagance which no one can afford.
- (d) Control of air pollution is necessary today, but the need for it will become increasingly urgent as the population, prosperity and automobile registration in Ontario increase.

Motor vehicle registration in Ontario is increasing at the rate of more than 100,000 vehicles per year. Hydrocarbon-oxidant effects attributable to automobiles include eye-irritation, vegetation damage, reduced visibility and the deterioration of rubber.

As soon as effective and practical devices to improve the quality of automobile exhaust become available, their attachment should be made mandatory on every gasoline powered motor vehicle in Ontario.

- (e) Although scientific evidence about the effects of air pollution on human health is far from complete, sufficient proof exists to make it abundantly and increasingly clear that air pollution is injurious to both physical and mental health. Under certain combinations of circumstances it can be fatal. It fosters disease, and is very probably a major cause of lung cancer.

- (f) In general, the Committee is satisfied that advances in science have now made it technically possible to eliminate, or to satisfactorily control, with the exception of motor vehicle exhaust, almost every kind of air pollution.
- (g) The problem is certain to gain in severity and public importance until the actual physical discomfort of the man on the street will force him to demand abrupt, drastic and expensive action as he has in Great Britain, Los Angeles, St. Louis, Pittsburgh and elsewhere. The Committee firmly believes that such an agonizing situation can be averted in Ontario through thorough and careful study at this time, followed by appropriate decisive action.
- (h) To have adequate air pollution control measures undertaken before an acute situation develops in Ontario, considerable public understanding and support are required.

Elsewhere, the effectiveness of laws, by-laws and ordinances and the degree of success obtained by officials in the control of air pollution appear to be in proportion to the amount of local public understanding of the subject.

- (i) The expression "free as the air you breathe" is as antiquated in modern civilized society as the coal oil lamp. Air costs each one of us a substantial amount of money whether it is clean or dirty. It is much more expensive to put up with polluted air than to pay the price of having air that is worth inhaling.
- (j) It is not unreasonable for the average industry to spend between 2% and 5% of its capital cost for air pollution control equipment. Such money is always well spent.
- (k) Almost without exception, every industry can clean itself up if it will take the trouble and spend the money.
- (l) Public opinion determines the pace of industry's attack on air pollution. Top management in the U.S.A. classifies air pollution as a major public relations problem. Industries who inform their neighbours of what they are doing to stop air pollution find that they earn, and receive, rich and unexpected dividends in public appreciation and good will which would be most difficult to gain in any other way.
- (m) Prevention is much cheaper than cure. Experience has shown that air pollution control expenses may be from two to five times as great when the correction is applied to an established, operating concern by "fitting the equipment in with a shoe horn", than they are when properly planned equipment is designed for and built into factories, or other buildings, when they are first constructed.

Everywhere the Committee has been where air pollution has developed into an acute and urgent problem, we have been asked to convey hearty congratulations back to the Government of Ontario for having had the foresight to do something about this problem before its consequences here assume such serious proportions and become so obvious to each citizen as to make him vociferously demand quick relief action.

"Panic Legislation" inspired by acute air pollution episodes is unlikely to be effective and will probably be unnecessarily costly. In such cases, since no time is permitted for adequate scientific study to discover the actual cause of the annoyance, any precipitate action taken has a good chance of being misdirected.

- (n) The control of air pollution, it should be made clear, is a function which cannot be satisfactorily administered without the full use of still-growing scientific knowledge, the utilization of technically qualified personnel and adequate laboratory and mobile test equipment, together with the strong support of an informed public opinion.
- (o) We have discovered no instance of an industry being prejudiced in its operations by being required to install adequate air pollution control equipment.
- (p) The old-fashioned idea was that a smoking chimney is a sign of full lunch pails and of prosperity. Today it is an indication of waste, of bad manners and of a source of unnecessary dirt and work for the housewife. It may also be a sign of full hospital beds. It is neither polite nor proper to dump your garbage on your neighbour's property. Neither is it legal.
- (q) Therefore this Committee is of the opinion that there should be no exemptions made in any air pollution control legislation which might be recommended to, or adopted by, this Legislative Assembly.
- (r) Because air pollution frequently represents waste, expenditure made for control equipment is, therefore, almost always likely to be a worth-while investment. Where chemicals and elements can be recovered by air pollution control methods, the profit therefrom can often more than pay for the installation and upkeep of the necessary apparatus.
- (s) However, in the rare instance where control is difficult and unusually costly, it might be considered desirable to extend some financial assistance to the industry concerned.

Or, perhaps in every case, it might be thought wise to extend some financial advantage to those corporations, or individuals, who promptly install the necessary equipment. This advantage might take the form of some tax relief, or maybe it would be desirable to set up a fund to provide interest-free loans for this purpose.

(t) It is obvious to us that industry is not alone to blame for polluted air and that it behooves every individual to be his own constant smoke inspector. For example, he should not burn leaves, trash or other open fires in his yard; he should not buy a home incinerator; he should learn how to properly and economically heat his own house; and he should keep his automobile, truck or motorcycle in good repair and adjustment, so that it runs as efficiently as possible and does not emit a smoky exhaust.

(u) As recommended by industry and municipalities, this Committee will give consideration to the advisability of recommending the establishment of a government agency (for example, a Commission or a separate division of the Department of Health), with an adequate budget to provide for sufficient technically qualified personnel and adequate modern scientific equipment.

The purpose of such an agency would be to accumulate up-to-date air pollution control information and to provide free advice and assistance to individuals and corporations (both municipal and industrial), on all problems of air pollution and their solution.

This agency should have sufficient and proper equipment to enable its staff to make surveys and analyses in municipalities and industries with difficult problems. It probably should also be equipped and staffed to carry out research in this complex field. **This is no job for amateurs.**

The proposed provincial agency should have direct control over all industry in the province to prevent an industry locating just outside the jurisdiction of any municipality, or in semi-urban areas, to avoid local control.

This agency should be qualified and capable to give reliable advice and information concerning the type of equipment which would be most suitable and which would provide the most economical results in the control of each type of air pollution problem.

It might be thought desirable to empower such a government agency to set standards from time to time for each type of air pollution control equipment which the manufacturer concerned must meet with his apparatus before it would be permitted to be sold in Ontario.

(v) The Committee is of the opinion that provincial legislation should be enacted to give the municipal authority the power and the duty to control the common and more simple types of air pollution within its boundaries, and, perhaps, immediately adjacent thereto.

This municipal control should include power to cause abatement of air pollution originating from railways passing through the municipality

and from steamships moored at docks within the municipal boundaries, or anchored or passing within one-half mile from the municipal shoreline.

- (w) We consider that new legislation will be required to control the air pollution from railways and shipping. It is possible that this annoyance may come under provincial jurisdiction as being a matter of "property and civil rights," or of health. However, our recommendations in this regard should await the findings of the International Joint Commission.

Since there is some conflict of informed opinion as to whether provincial legislation, in so far as it would apply to air pollution originating from railways and shipping, would be *ultra vires*, it might be expedient to pass such necessary legislation on the assumption that the province has the right to legislate concerning such nuisances for which our Dominion authority is not assuming proper responsibility.

Ontario municipalities have been unanimous in placing the blame for a large proportion of their air pollution on railway operation. If our Federal authority continues to neglect this problem as it has to date, and Provincial Legislation is passed to remedy the situation, and if the *vires* of such legislation were challenged in the courts, it is difficult to conceive that the courts would permit railways to operate so as to discharge an unreasonable and unnecessary amount of smoke with disregard to the health, welfare and convenience of the inhabitants of the various Ontario communities through or near which they travel. Therefore, it would be desirable to pass legislation in this matter and to give the courts an opportunity to express their opinion should the railways see fit to challenge the *vires* of the legislation.

- (x) The Committee wishes to have the opportunity before making final recommendations, to gather more evidence concerning the amount of control which municipalities can competently and economically exercise in these matters; the problems of central control; limitations and safeguards required; and many other questions in this field for which we do not as yet have the answers.
- (y) An individual who resides in a rural part of the province should not assume that he is free of the burden of air pollution merely because he lives in the country. He, too, pays in one way or another for air pollution. He always pays indirectly, and frequently, may also pay directly.
- (z) Air pollution is a matter of concern to all Political Parties and transcends Party lines just as it knows no territorial boundaries. It is in the interest of everybody in the province to do a good job on air pollution control.

Appendix "B"

A PROPOSED ACT— THE AIR POLLUTION CONTROL ACT

The purpose of this bill is to provide for the establishment of the Ontario Air Pollution Control Commission. Explanatory Note.

The provisions of the bill are self-explanatory.

THE AIR POLLUTION CONTROL ACT

An Act to establish the Ontario Air Pollution Control Commission to control Air Pollution.

1. In this Act,

Interpretation.

- (a) "atmosphere" means the outdoor atmosphere, and does not include the air inside factories or other buildings;
- (b) "air contaminant" means any matter, substance or odour, whether liquid, vapour, gas, aerosol, fume or solid, and including pollen and radioactive or any other radiations or emissions of any kind or nature put into or allowed to escape into the atmosphere;
- (c) "air pollution" means the presence in the atmosphere of one or more air contaminants, with or without any reaction products which may result from the interaction in the atmosphere of the air contaminants;
- (d) "air pollution control" means the prevention from entering the atmosphere of all or of the greatest possible proportion of an air contaminant or air contaminants produced by a source, and the reduction of the total amount of air pollution to the smallest possible minimum;
- (e) "Air Pollution Control District" means any geographical area or district within the province which may encompass one or more municipalities, or a part or parts of a municipi-

pality or municipalities, as designated from time to time by the Commission;

- (f) "air pollution nuisance" means the emission or escape into the atmosphere of any air contaminant or contaminants in such a manner and of such quality and quantity as to interfere with the health, comfort, repose, living conditions, welfare or safety of, or as to cause annoyance, sensory irritation or nausea to any person or persons, or as to produce injury or damage to real or personal property, or as to interfere with visibility or the normal conduct of transportation or business; but excludes all aspects of employer-employee relationship as to health and safety hazards inside factories or other buildings;
- (g) "Chairman" means the chairman or acting chairman of the Commission;
- (h) "code" means a rule or rules as formulated, promulgated, or amended from time to time by the Commission under this Act;
- (i) "Commission" means the Ontario Air Pollution Control Commission;
- (j) "District Authority" means an air pollution control authority established by the Commission to be responsible to the Commission for the control of air pollution and air pollution nuisances in an air pollution control district;
- (k) "General Manager" means the chief administrative officer in charge of the affairs of the Commission;
- (l) "Minister" means the member of the Executive Council designated by the Lieutenant-Governor in Council to administer this Act;
- (m) "municipality" means any metropolitan area, city, town, village, police village, improvement district, county, township or any of the territorial districts set forth in The Territorial Division Act;
- (n) "regulations" means regulations made under this Act;

- (o) "unorganized territory" means those parts of the province which are without municipal organization.
2. The Lieutenant-Governor in Council may from time to time designate a member of the Executive Council to administer this Act. Responsible Minister.
 3. (1) There is hereby constituted on behalf of Her Majesty in right of Ontario a corporation without share capital under the name "Ontario Air Pollution Control Commission" which shall be composed of not fewer than three persons as the Lieutenant-Governor in Council from time to time determines. Commission established.
 - (2) The members of the Commission shall be appointed by the Lieutenant-Governor in Council and one of them shall be designated as chairman and one of them may be designated as vice-chairman.
 4. The chairman, the vice-chairman, if any, and the other member or members, as the case may be, of the Commission shall receive such remuneration for their services as the Lieutenant-Governor in Council determines. Remuneration.
 5. The Lieutenant-Governor in Council may from time to time fill any vacancy in the membership of the Commission. Vacancies.
 6. A majority of the members of the Commission shall constitute a quorum. Quorum.
 7. The Commission may appoint and employ upon such terms of employment as it deems desirable a General Manager and such other officers and employees as it deems requisite. Officers and employees.
 8. Every person who is entrusted by the Commission with the custody or control of money in the course of his employment shall give security in the manner and form provided by The Public Officers Act. Security by officers.
R.S.O. 1950,
c. 311.
 9. The administrative expenses of the Commission, including the remuneration, salaries and expenses of the members of the Commission, its officers and employees, may be paid out of such moneys as are appropriated therefor by the Legis-

lature, or out of such moneys as accrue from the operations of the Commission.

Function.	10. It is the function of the Commission and it has power,
Control.	(a) to prescribe and enforce air pollution control on every stationary and moving source of air contaminants, including boats and railways;
System.	(b) to develop, administer, enforce and ensure the continuance throughout Ontario of a comprehensive air pollution control system;
Definitions, standards, limits, etc.	(c) to establish, approve and publish definitions, standards, limits and permissible levels dealing with air contaminants, air pollution and air pollution nuisances and to extend, revise and republish these from time to time as medical, scientific and engineering knowledge progress;
Air Pollution Control District.	(d) to designate any area as an Air Pollution Control District and, in the case of lack of mutual agreement among and between any municipalities which are included, all or in part, in the district, to assess each municipality with its separate share of the costs of establishing and operating the District Authority and to recover from each municipality its portion of the said costs;
Fundamental Air Pollution Code.	(e) to prescribe the provisions of a fundamental air pollution control code which every municipality shall enforce, except those which are, from time to time, exempted by the Commission;
Investigation and abatement.	(f) to investigate any source of air contaminant or contaminants or air pollution nuisance in any municipality or in unorganized territory, and to have the air contaminant or contaminants controlled or the nuisance abated by any means including prosecution of the person or persons responsible, and, if the air contaminant or contaminants or the air pollution nuisance should have been controlled by a municipality in accordance with the fundamental air pollution control code, to assess that municipality for the actual costs of investigating and abating the air pollution or air pollution nuisance and to recover from the municipality the said costs;

- (g) to delegate by means of a special code to any municipality which is willing and able to provide trained personnel and equipment adequate to meet the requirements of the Commission, the right and power to control the emission of air contaminants and air pollution nuisances other than those included in the fundamental air pollution control code which, in the opinion of the Commission, it is able to adequately control;

Special codes.
- (h) to remove from any municipality which is not, in the opinion of the Commission, adequately controlling the air contaminants and air pollution nuisances it is authorized to control under subsection (g) the right and power to control these contaminants and nuisances;

Removal of power.
- (i) to provide professional assistance and advice in air pollution matters to any municipality, industry or person which requests such assistance or advice;

Assistance and advice.
- (j) to conduct and supervise surveys, tours of inspection and research programs related to air pollution, and to consult with federal and other provincial government departments, provinces and countries to obtain and compile information and statistics for its purposes and to keep its information and statistics abreast with advances pertaining thereto;

Surveys, research, consultation, etc.
- (k) to receive grants of money and/or equipment from any donor for the purpose of financing and promoting research on problems related to air pollution, its causes, effects, hazards and control, and to use the money or equipment for research undertaken by the Commission, or to distribute it to universities or other research centres for research approved by the Commission;

Grants to promote research.
- (l) to conduct and supervise educational programs and projects by any means, including the preparation, publication and distribution of information and statistics relating to air pollution and air pollution control;

Public education.
- (m) to encourage, by any means, architects, engineers, physicians, scientists and technologists to study, enter and specialize in the field of air pollution, including the granting of scholarships and the establishment of fellow-

Scholarships, etc.

ships for post-graduate work at appropriate universities, as authorized by the Lieutenant-Governor in Council, to those who, in the opinion of the Commission, are deserving and capable;

Authority to enter, inspect, etc.

- (n) to authorize any of the employees of the Commission to enter and inspect any land, building, place and equipment for the purposes of investigating an actual or suspected source of air contaminant or contaminants or of an air pollution nuisance, ascertaining compliance or noncompliance with any code or rules of the Commission or the regulations, and taking samples for analysis;

Complaints, hearings, prosecutions, etc.

- (o) to receive or initiate complaints against air pollution nuisances or the emission of air contaminants, to hold hearings in connection with air pollution investigations and to institute prosecutions and take all proceedings necessary for the prevention or control of air pollution or air pollution nuisances and for the recovery of penalties as prescribed by the regulations or a code;

Permit system.

- (p) to establish a permit system to ensure the examination, before any construction is begun, of plans, blueprints and information concerning processes and equipment and after construction is completed, but before the plant, processes and equipment are put into operation, of the structure, processes and equipment so that, as nearly as may be determined, any air pollution control equipment to be installed in any building and any business or manufacturing or other process to be established will be so established, designed, constructed and operated as to control air pollution and to comply with the regulations and the codes and rules of the Commission with regard to air contaminants and air pollution nuisances, and, in the discretion of the Commission, to delegate to any municipality or municipalities the power and the duty to operate such a permit system;

Time allowed for compliance, when necessary.

- (q) to grant to any person who is violating any code or rule of the Commission a reasonable period of time, as determined by the Commission, during which such person shall be required to take such measures as may be necessary in the opinion of the Commission to bring a stop to the violation, and to require such person to make progress

reports to the Commission at such time or times as shall be determined by the Commission; and

- (r) to prevent any business, plant, factory or process from starting operations without having first obtained an operating permit and to cause to cease operating any business, plant, factory or process, or any portion thereof, which fails, after reasonable notice, to comply with the regulations and the codes and rules of the Commission.

Power to prevent starting and to close.

11. (1) Any information concerning the details of secret processes or methods of manufacture or production revealed to the Commission by any person shall be kept secret and shall not be published by the Commission in its annual report, or otherwise, if so requested by the person.

Certain information to be secret.

- (2) Information, other than that referred to in subsection 1, obtained by the Commission in the course of any investigation, inspection, test, analysis or hearing, shall be kept confidential by the Commission, if requested to do so, except that information, statistics and figures which relate directly to air contaminants, air pollution, air pollution nuisances and the control thereof may be published by the Commission.

12. Upon the recommendation of the Commission to the Minister, the Lieutenant-Governor in Council may make such regulations, not inconsistent with this Act, as may be deemed necessary for,

Regulations.

- (a) the carrying out and enforcing of the provisions of this Act;
- (b) the efficient administration of this Act by the Commission;
- (c) prescribing the penalties to be imposed on any person who, without good and sufficient cause, the proof whereof lies on him, violates, or refuses, neglects or fails to comply with any regulation, or with any provision contained in any code, rule or order of the Commission;
- (d) prescribing the penalties which may be imposed personally on any director or officer, or directors or officers of

any corporation who assents or assent to, or acquiesces or acquiesce in any violation of or refusal, neglect or failure to comply with any regulation or with any provision or provisions contained in any code, rule or order of the Commission, or who obstructs or gives instructions to the effect that entry or information be refused to any employee of the Commission charged with the duty of making an inspection, investigation or of taking samples for analysis;

- (e) prescribing the penalties, by means of the suspension and withholding of grants or the making of deductions from grants or otherwise, for any municipality which violates, or refuses, neglects or fails to comply with any regulation, or with any provision contained in any code, rule or order of the Commission; and
- (f) prescribing the amount or amounts which may be granted by the Commission for scholarships or fellowships for the study of subjects related to air pollution and prescribing the conditions which must be satisfied by a trainee to qualify for a scholarship or fellowship and for the period during which he must give return of service within the Province of Ontario after completing his training.

Witnesses,
evidence, etc.

13. In conducting any inquiry, investigation, hearing, action, proceeding or prosecution, the Commission has all the powers that may be conferred upon a commissioner under The Public Inquiries Act.

R.S.O., 1950
c. 308

Commission's
orders not
subject to
review.

14. No code, definition, standard, limit, permissible level, decision, order, direction, declaration or ruling issued by the Commission shall be questioned or reviewed in any court, and no order shall be made or process entered, or proceedings taken in any court, whether by way of injunction, declaratory judgment, certiorari, mandamus, prohibition, quo warranto, or otherwise, to question, review, prohibit or restrain the Commission or any of its proceedings.

No liability
for errors,
etc.

15. Neither the Commission nor the Province of Ontario incurs any liability to any municipality or person by reason of any error or omission in any advice, report, estimate, statement, definition, standard, limit, permissible level, result of

- research, or other information or statistic of any nature which may be obtained from or published by the Commission.
16. No member of the Commission, nor its general manager, nor any of its other officers, nor any of its clerks or servants shall be required to give testimony in any civil suit respecting information obtained in the discharge of their duties under this Act. Protection from being called as witness.
17. No existing civil right of action or criminal remedy for any neglect or wrongful act which is in violation of any regulation, or any code or rule of the Commission shall be excluded or impaired by this Act. Existing remedy not impaired.
18. (1) The Commission shall make a report annually to the Minister containing such information as the Minister may require. Annual report.
- (2) A copy of the report shall be filed with the Provincial Secretary who shall submit the report to the Lieutenant-Governor in Council and shall then lay the report before the Assembly, if it is in session, or if not, at the next ensuing session. Idem.
19. "The Corporations Act, 1953," as amended from time to time, does not apply to the Commission. 1953, c. 19, not applicable.
20. In the event of conflict between any provision of this Act and any provision of any other Act, the provision of this Act prevails. Conflict.
21. This Act comes into force on the day it receives Royal Assent. Commencement.
22. This Act may be cited as The Air Pollution Control Act, 1957. Short title.

Appendix "C"

July 13, 1956.

**PROPOSED REVISION TO GENERAL ORDER No. 18 (Order No. 5678)
ISSUED BY THE BOARD OF TRANSPORT COMMISSIONERS FOR CANADA,
DATED NOVEMBER 1908.**

**(Drafted by the Select Committee of the Ontario Legislative Assembly on
Air Pollution and Smoke Control.)**

IT IS ORDERED THAT:—

1. In this Order every reference by number to smoke density shall refer to the density of smoke as measured by the same number on the Ringelmann Smoke Chart as published and used by the United States Bureau of Mines.

2. Every steam or diesel engine or locomotive, stationary boiler, portable boiler, steam generator, power plant and engine house, operated in the Province of Ontario by any Railway Company subject to the legislative authority of the Parliament of Canada, shall be equipped, fueled and operated in such a manner that it will not infringe the following provisions.

3. Railways shall be subject to the provisions herein contained when operating in those municipalities, or areas, within the Province of Ontario that have passed, or may hereafter pass by-laws for the regulation, control, or prohibition of smoke or other air pollutants, or by-laws to the like effect. This Order shall not apply to Railways when operating in a municipality, or area, which does not provide an officer or official to administer the air pollution control or smoke control by-laws of that municipality.

4. At no time shall any stationary or moving equipment operated by a Railway Company emit smoke of a density greater than No. 3.

5. At no time shall any diesel powered stationary or moving equipment operated by a Railway Company emit smoke of a density greater than No. 2.

6. Each diesel engine operated by a Railway Company shall be maintained in first-class adjustment and working order. A diesel shall be deemed not to be in first-class adjustment and working order if the exhaust gases therefrom contain carbon monoxide in excess of twenty-five hundred parts per million (2,500

P.P.M.),* or if the exhaust gases are nauseating and/or physically irritating to persons in the vicinity of the operation of the engine.

7. Locomotives in service, or ready for service, shall not emit smoke of a density equal to, or greater than No. 2, except that smoke of a density equal to, but not greater than No. 3 shall be permitted for a period, or periods aggregating a maximum of ninety (90) seconds in any ten (10) minute period.

8. When a fire box is being cleaned out, or a new fire is being built and ignited, a locomotive, stationary boiler, portable boiler, power plant, or steam generator shall not emit smoke of a density equal to or greater than No. 2, except that smoke equal to, but not greater than No. 3 in density shall be permitted for a period, or periods aggregating not more than a maximum of three (3) minutes in any fifteen (15) minute period.

9. Each single locomotive stack, or other outlet through which smoke emerges from an engine house in which locomotives are repaired, serviced, cleaned and/or housed, shall not emit smoke of a density equal to or greater than No. 2, except that smoke equal to, but not greater than No. 3 shall be permitted for a period, or periods aggregating not more than a maximum of three (3) minutes in any fifteen (15) minute period. Where a common stack is provided through which the emissions of more than one locomotive can pass, this provision shall apply to each single locomotive stack which takes the emissions from one locomotive and before those emissions are fed into the common stack.

10. An automatic smoke density measuring instrument shall be provided and kept in good working order on each single locomotive stack of an engine house, with a visible indicator located so as to be conveniently seen by a full-time employee who has been properly instructed concerning railway air pollution control. Each such instrument shall be calibrated to show the Ringelmann Smoke Numbers and provided with an alarm set to operate when the smoke emitted through the stack to which it is connected is of a density greater than No. 3.

11. The control, regulation or elimination of smoke, dust, fly-ash, soot, fumes, or other solid or gaseous products of combustion from any fuel burning equipment, internal combustion engine, vehicle, outside open fire, or premises and equipment not otherwise provided for in this Order shall be subject to such smoke or air pollution control by-laws which have been or may be enacted by any municipality or area in the Province of Ontario in which the premises are, or equipment is situated.

*Twenty-five hundred parts per million might well prove to be not a low enough limit for the purpose, or research might develop some other criterion which would be more practical and accurate as a measure of maladjustment of a diesel engine. It is the Committee's opinion that this is a most lenient provision and it is included to indicate that some objective method should be specified which will show when a diesel locomotive is not in proper working order and requires servicing.

12. Any duly appointed official or officials of a smoke abatement, air pollution control, or like department or bureau of a municipality, of a control area, or of the Province of Ontario, shall be permitted entry into and upon any Railway property at any time for the purpose of making observations, measurements, and/or other investigations necessary to enforce the provisions of this Order.

13. Each Railway Company shall make available to any duly appointed official, or officials, mentioned in paragraph 12, such information as they may request pertaining to the railway operations, lists of locomotives in use in the municipality or area, and data relative to boiler ratings, capacities, burning rates, stoker equipment, overfire air jets, overfire steam jets, the type of fuel used, lighting-up equipment and similar information having a bearing upon the production of smoke and its control.

14. Anyone hindering, obstructing or preventing an official mentioned in paragraph 12 from the performance of his duty shall be deemed guilty of an offence under this Order.

15. A Railway Company shall prepare regular reports at intervals not longer than every three (3) months indicating progress on smoke elimination and control which has been made by that company during the interval since its preceding report and including information concerning changes which have been made in equipment used and in its operations likely to affect the air pollution problem, and any action taken by the Railway Company against violators or offenders under this Order who are in the employ of the company. A copy of each report shall be provided to each municipality, or air pollution control area, which is included in the district covered by the report.

16. It shall be a defence for an employee of a Railway Company who is charged with violating a provision of this Order to show that the violation occurred because he was provided by the Railway Company with inadequate equipment, with equipment in poor repair, or that the equipment had broken down as the result of an accident which could not have been foreseen and was not the result of his own negligence or malfeasance.

17. It shall be a defence for a Railway Company charged with violating a provision of this Order, to show that the violation was caused by an Act of God, or was beyond possible control by the company or its employees.

18. Every company and every person who violates the provisions herein contained, or any one of them, shall be guilty of an offence and subject to the penalties hereinafter provided on conviction by any court that may be sitting and have jurisdiction in the municipality or area in which the violation occurred.

19. A company shall be subject to a penalty of \$100.00 for the first offence, \$300.00 for the second offence and \$500.00 for each subsequent offence.

20. A person shall be subject to a penalty of \$25.00 for the first offence, \$50.00 for the second offence, and \$75.00 for each subsequent offence.

21. This Order shall come into effect twelve months after the passing thereof.

Appendix "D"

SOME EFFECTS OF THREE COMMON AIR CONTAMINANTS

(1) CARBON MONOXIDE is a colourless, odourless, non-irritant gas which cannot be perceived by the senses. The sources of carbon monoxide are many, as every incomplete combustion of any fuel containing carbon produces this treacherous gas. Automobile exhaust is one well-known source of carbon monoxide and sufficient can be produced by a car with its motor idling in a closed garage to kill within a few minutes.

Because the density of carbon monoxide is almost the same as that of air (0.967), it is not inclined to rise quickly from ground level, particularly on days when the atmosphere hangs heavy, and certainly not when a temperature inversion exists. Therefore motorists in heavy traffic are breathing a modern miasma which, recent tests show, spreads for a considerable distance from the road.

When carbon monoxide is inhaled it passes through the lungs into the blood stream and there it combines with haemoglobin with an affinity that is some three hundred times greater than that of oxygen. By uniting with the haemoglobin it renders the latter incapable of carrying oxygen throughout the body. In addition to this anaemia-like or asphyxia effect, the presence of carboxyhaemoglobin in the blood stream interferes with the dissociation of oxygen from its haemoglobin. Hence, an individual with an anaemia, or lack of haemoglobin in the blood stream of, say, 40% is better off than a person suffering from a blood stream carbon monoxide saturation of 40%.

When a person has absorbed carbon monoxide into his blood to the extent of 10%, he will not be functioning at his normal full efficiency, but there are rarely any specific symptoms he can put his finger on. However, such a man is worse off than one with a 10% anaemia. At a 20% concentration of carboxyhaemoglobin, symptoms appear on slight exertion, such as, shortness of breath, giddiness and headaches. At 30% concentration these symptoms appear at rest, and concentrations of from 30% to 50% cause severe headache, mental confusion, dizziness, impairment of vision and hearing, and collapse and fainting on exertion. With concentrations of 50% to 60% unconsciousness results, and death may follow if exposure is of appreciable length of time. Concentrations of 80% cause almost immediate death.

Several blood samples taken from taxi-cab drivers in one large city in the United States showed that on various occasions the carbon monoxide level in their blood ran between 8% and 20%. We would like to see the results of more research on this to determine to what extent such concentrations of this poison in the blood stream interfere with the driver's reaction time and his ability to make quick decisions.

The "maximum allowable concentration" of carbon monoxide in the air permitted by industrial hygienists for a working man exposed to the gas for only 8 hours per day is said to be 100 parts per million.

We are certain that this M.A.C. level was established years ago without any thought being given to generalized air pollution and based on the assumption, which no longer holds, that the working man would have 16 hours in the 24 in which his body could recover from the working hours' exposure by breathing air completely free of carbon monoxide. We are of the opinion that for persons exposed to the gas for 24 hours per day, such as those working and living near a heavily travelled roadway, the M.A.C. should be very much lower than 100 p.p.m. While considerable investigation must be done on this matter, we would estimate that for a 24-hour exposure the M.A.C. for carbon monoxide should average much less than 10 p.p.m. for perfectly good health.

A scientific survey published by the Air Pollution Foundation of Los Angeles in December 1956, gives an analysis of the air near heavy traffic arteries. Without going into the details of this careful piece of work with regard to other air contaminants produced by automobile exhaust, we wish to point out that with respect to carbon monoxide alone, the following concentrations were measured along six different traffic arteries in the Los Angeles basin. At a distance within 10 feet from the curb, carbon monoxide concentrations were measured mostly within the range from 25 to 45 p.p.m., and the peak reached was 73.9 p.p.m. Samples were also taken at 25 and 50 feet from the road. Most of the readings taken 25 feet away were recorded from 20 to 40 p.p.m., with a high of 93.2 p.p.m. At 50 feet away, the general average concentration indicated by the readings dropped off a little, but a top value of 83.5 p.p.m. was recorded.

A few preliminary tests made on downtown Toronto streets indicate that the carbon monoxide concentrations on, and in the vicinity of our traffic arteries are just as high as those reported in the Los Angeles study.

We are of the opinion that traffic conditions in large cities, with uncontrolled exhausts from automobiles, trucks, busses and motorcycles, are capable of producing in city dwellers the effects of anaemia because of the amount of carbon monoxide in the air. On occasion, in very congested traffic conditions, it is quite conceivable that the carbon monoxide concentration in the blood of a

particularly susceptible individual could rise to such a level as to produce mental slowness and confusion in him sufficient to be the cause of an accident on the road.

Above, we referred to the greater affinity for carbon monoxide shown by haemoglobin as compared to that for oxygen. This means that when the blood in the lungs is exposed to air containing equal concentrations of oxygen and carbon monoxide, it will absorb 300 parts of the monoxide for every one part of the oxygen. As a result of this preference shown by haemoglobin, a concentration of as little as 0.2% of carbon monoxide in an atmosphere, which is otherwise normal in composition, will result in death if breathed for a few minutes.

It is well known that the anoxia produced by poisoning the blood with carbon monoxide, even to a relatively slight degree, will cause most people to become stubborn, perverse or unruly. We wonder to what extent the carbon monoxide poisoning which is occurring on our streets and highways is responsible for the stubbornness, selfishness and lack of consideration and courtesy which is so apparent in the behaviour of many of our pedestrians and drivers. Also to what extent these behaviour reactions are responsible for our mounting accident statistics.

Aside from studies which should be done on the effects of other air contaminants, of which there are a great number, this Committee would particularly like to see research carried on in the larger Ontario cities concerning the amount of carbon monoxide in the city atmosphere, the percentage of carboxyhaemoglobin in the blood of our city dwellers (especially policemen and others exposed to traffic for long hours), and the effects thereby produced on representative citizens.

(2) ALDEHYDES. Two typical aldehydes which contaminate the atmosphere are Formaldehyde and Acetaldehyde.

(a) **FORMALDEHYDE** is a colourless gas with a pungent odour. The maximum allowable concentration in the air for an 8-hour exposure in industry is now said to be 5 parts per million. Not long ago 20 p.p.m. was permitted, but this value had to be lowered. We believe that even 5 p.p.m. of formaldehyde in the air is probably too much for good health. Sensitive persons find eye irritation is produced by concentrations as low as 0.25 p.p.m.

Formaldehyde is only very slightly lighter than air. In very low concentrations its vapour produces intense burning and watering of the eyes, with great irritation of the mucous membranes of the nose, mouth, throat and bronchial tubes.

Exposure to heavier concentrations causes cough, dyspnoea, bronchitis, general weakness, palpitations, sleeplessness, loss of appetite, headache, and a tightness of the chest caused by oedema and congestion of the bronchial tubes

and the lung parenchyma. An exposure to 50 p.p.m. of formaldehyde in the air is unendurable to breathe, and there has been an occasional death reported in industrial accidents caused by formaldehyde-produced spasm of the muscles of the larynx.

On contact with living tissue formaldehyde changes into formic acid (the "sting" of a bee is due to the insertion of formic acid under the skin), and methyl alcohol. An irritating dermatitis is the result of such a contact of formaldehyde in the air with the skin, when prolonged for several hours. Formaldehyde also reacts with tissue proteins to form irreversible compounds, making the process of healing a slow one.

(b) ACETALDEHYDE is a colourless volatile liquid with a fruity odour. As a vapour, it is one and a half times heavier than air and hence it does not readily rise from ground level, where it accumulates to irritate man and beast. Fortunately, it is not as toxic as formaldehyde (its M.A.C. is set at 200 p.p.m.), but it is very irritating to mucous membranes, and most people find that a concentration in the air of about 40 p.p.m. is irritating to the eyes.

In those who are sensitive to acetaldehyde, it can produce urticaria and asthmatic attacks.

It possesses anaesthetic properties and can kill by respiratory paralysis when inhaled in high concentrations.

For the average person, exposure to moderately severe concentrations of the vapour may cause cough, dyspnoea, rhinitis, bronchitis, tachycardia, conjunctivitis and night sweats.

A chemical process called polymerization readily occurs with both formaldehyde and acetaldehyde resulting in the formation of new substances. Polymerization is one of the reactions to which we have referred that take place in the atmosphere in the presence of sunlight. Such reactions complicate the air pollution picture and make it all the more serious, because new compounds are produced and carried in the air which were never emitted into it from the original sources of contamination.

In addition, acetaldehyde will react with sulphuric acid to produce paraldehyde. Paraldehyde is a drug which is used in medicine for its sedative properties. Sulphuric acid mist is a fairly common atmospheric contaminant over practically every city. The oxides of sulphur are formed by the combustion of many types of fuel, from coal to gasoline. The sulphur trioxide can make sulphuric acid mist directly with the water vapour in the air. The sulphur dioxide, combined with oxidants in the atmosphere, like ozone and various peroxides, in sunlight will oxidize to sulphur trioxide. Therefore, it is quite possible that paraldehyde is formed as one of the products of the atmospheric chemical reactions which go on, and that we are inhaling yet another soporific,

in the form of paraldehyde, with the city air pollution we have to breathe. To what extent this is going on is just another of the many matters which urgently require the attention of the research scientists of the proposed Commission.

(3) OXIDES OF NITROGEN. There are six oxides of nitrogen. Nitrous oxide, nitrogen dioxide and nitrogen tetroxide are the three of most significance from an air pollution viewpoint. The nitric oxide is quickly oxidized in the air to the dioxide form.

Oxides of nitrogen are very common air contaminants because they are produced by practically every kind of combustion and by many industrial processes. Electric and oxyacetylene torch welding, for example, are prolific sources of nitrogen oxides. These oxides are formed in greatest quantities whenever combustion products at high temperatures are rapidly cooled. Industrial furnaces may release up to 500 parts per million, or more, of nitrogen oxides in their waste gases. The exhausts from internal combustion engines have been analysed to contain over 4,000 p.p.m. of oxides of nitrogen during acceleration, and over 1,500 p.p.m. while cruising. Hence, automobiles, trucks and busses are another potent source of this kind of air pollution.

Industrial hygienists have now lowered to 5 p.p.m. the maximum allowable concentration of nitrogen dioxide in the air which a working man is permitted to breathe for 8 hours every week day. At one time, this M.A.C. was set as high as 25 p.p.m. in some jurisdictions.

Concentrations lower than 2 p.p.m. of nitrogen dioxide in the atmosphere have been shown to produce "typical smog type of damage to vegetation". However, we believe that nitrogen oxides should be the cause of concern more because of their threat to human health than because of the substantial financial loss which must result from the damage they produce in crops and other vegetation.

Nitrogen oxides in low concentrations have several insidious features in common with carbon monoxide. One is that they do not give the victim any warning of their presence in the air he is breathing. Dangerous amounts of nitrogen oxide fumes may be inhaled before the slightest discomfort is noticed.

Even in an industrial accident exposure to very large amounts (i.e. more than 70 p.p.m.), which are sufficient to cause immediate irritation to the nose, throat and chest, together with coughing, the situation has often not been considered significant because on giving the victim fresh air to breathe his symptoms have disappeared and he has felt quite well again for from 10 to 20 hours. However, its proper importance has been realized the following day, too late, when the doomed man suddenly complains of tightness and burning in his chest, shortness of breath, restlessness and other symptoms, and looks cyanosed. If the exposure had been severe, he would then go on to

unconsciousness and death. If the man had not inhaled sufficient of the oxides of nitrogen to cause death, he would very probably suffer sequelae like pneumonia, lung abscesses, bronchiectasis or emphysema.

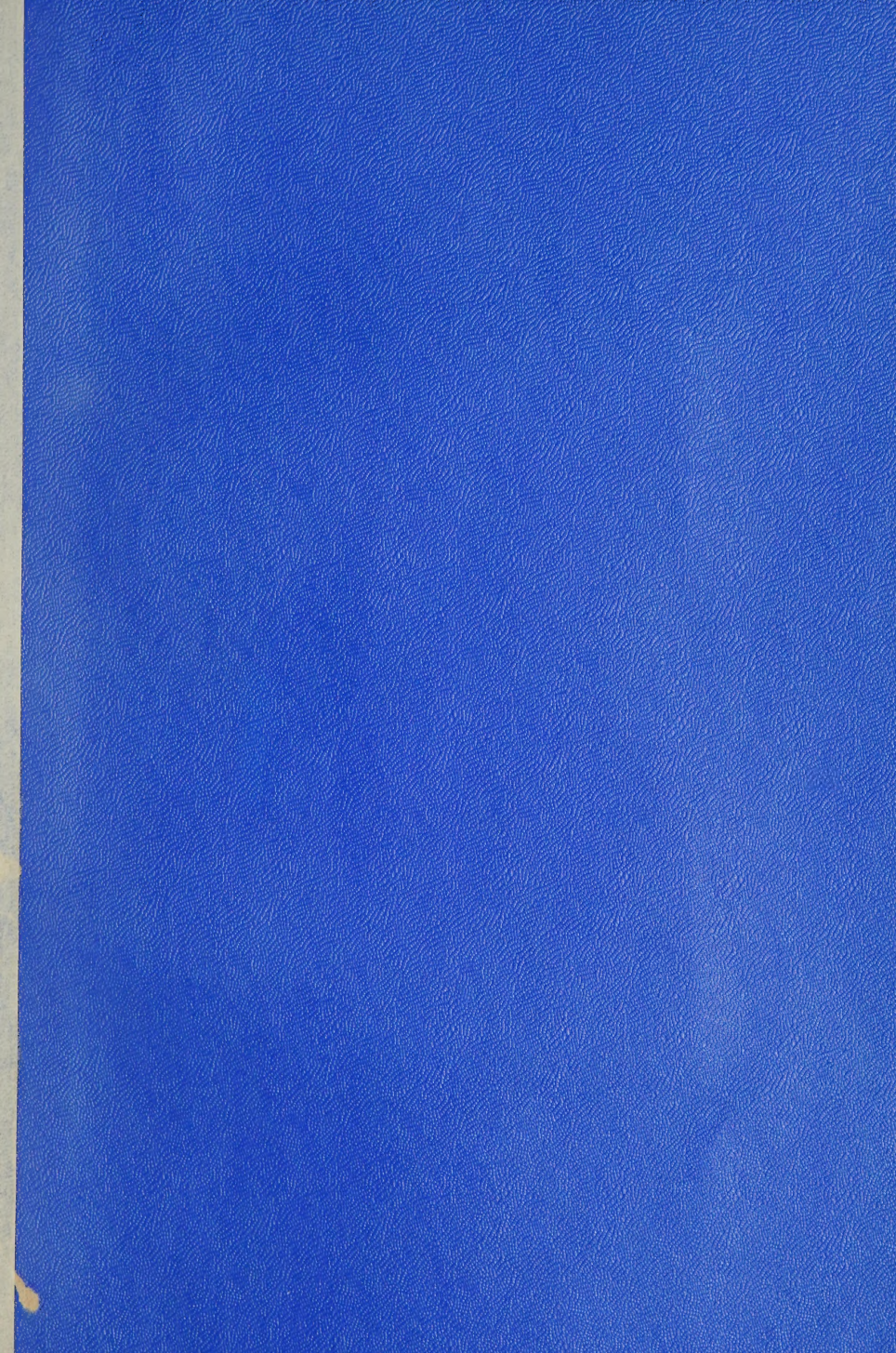
In the lungs the oxides of nitrogen form nitric and nitrous acids. These are most corrosive and irritating. They cause oedema and congestion of the bronchi and the lung parenchyma. In addition, these acids react with tissue alkalis to form nitrates and nitrites. The nitrites produce methaemoglobinaemia and, if in sufficient quantities, can cause a fall in blood pressure, headache, weakness and dizziness.

Continued or repeated exposure to fairly low concentrations of nitrogen oxide fumes (far less than the amount necessary to cause pulmonary oedema), can produce chronic irritation of the respiratory tract, cough, loss of appetite, gradual loss of vitality and corrosion of the teeth. The constant irritation to the lungs will lower the person's resistance to attacks of pneumonia.

Experiments performed in which animals were exposed to low concentrations of nitrogen dioxide, for periods of 4 hours per day for from 10 to 24 days, indicate that repeated exposures to nitrogen oxide concentrations which are far below the level required to produce obvious symptoms, can result in the formation of patches of emphysema in the lungs of those individuals who are susceptible to such damage. Once established in the lungs, emphysema remains as a permanent disability.

In addition to the many direct effects of the oxides of nitrogen on the body, they are also of great importance because they either take part in, or have a catalytic action in a great many of the reactions which go on in the atmosphere involving other air contaminants. In this great outdoor chemistry laboratory, the nitrogen oxides help to form a number of objectionable nitrogen containing compounds, some of which, we believe, can have deleterious effects on human and animal health. There still is a vast amount for science to learn about this "outdoor chemistry". We are not even sure at this stage of our knowledge just how many compounds are being, or can in the future be, produced in these atmospheric reactions in which the oxides of nitrogen are implicated. Neither do we know to what extent the unknown products of these reactions might be affecting our health.





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